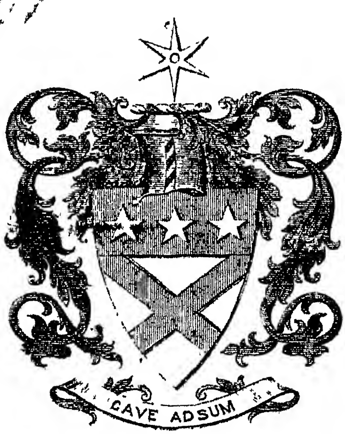
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TRANSACTIONS

OF THE

HIGHLAND AND AGRICULTURAL SOCIETY

OF

SCOTLAND.

TRANSACTIONS

OF THE

HIGHLAND AND AGRICULTURAL SOCIETY OF SCOTLAND.

JULY 1851—MARCH 1853.

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CONTENTS.

TRANSACTIONS

OF THE

HIGHLAND AND AGRICULTURAL SOCIETY OF SCOTLAND.

PRELIMINARY NOTICE.

It has been customary for the Directors to prefix to the first number of each volume of the Transactions a "Preliminary Notice," briefly setting forth the progress of the Society, and the objects which have chiefly engaged its attention during the two preceding years. The number of the Transactions published in March having completed the fourth volume of the new series, it becomes the duty of the Directors to issue the usual statement, which, it is believed, must prove satisfactory on all points connected with the position, prosperity, and efficiency of the Society.

Members.—In introducing the two last volumes, the Directors ventured to anticipate that the Society would continue to command the countenance and co-operation of the agriculturists of the country, and maintain its place in public opinion as an institution of national importance and deserving of support. The surest test of this is to be found in the increase of its members. Since 1849 the list has been subjected to a rigorous revision; the names of many, whose decease had escaped notice, have been expunged; while others have been permitted to retire, who from circumstances were led to tender their resignations. The more frequent vacancies, now annually occurring among the older members, must also be kept in view when estimating the numerical strength. In these circumstances, it affords the Directors much gratification to report that the Society has now on its roll 2775 names—a greater number than has appeared at any previous period of its history. A mere maintenance of existing

strength would be creditable to a body so long established; but an increase of one hundred and twenty, within two years, affords a significant proof of its vitality.

An important measure connected with membership was recently sanctioned. Previously, the subscription of twelve guineas for life, or of £1, 3s. 6d. annually, was payable by members of all classes; but it was suggested that a differential rate should be established in favour of tenant-farmers. The Directors were of opinion that such a concession was equitable, and that a tenant was fairly entitled to join the Society at a smaller contribution than a proprietor, his interest in the land being in general neither so extensive nor of so permanent a character. They considered, also, that it would have the effect of establishing the desire of the Society to extend its connection with the practical agriculturists of the country, and of removing an impression erroneously entertained in some quarters, that it is exclusively a body of landowners. After ascertaining that the change would be acceptable to those for whose benefit it was intended, the Directors submitted a proposal to the General Meeting in January 1850, that all tenant-farmers, members of any Local Agricultural Society, should be eligible for election on payment of five guineas for life, or of ten shillings annually. This was, in terms of the charter, again brought before a General Meeting in June 1850, when a bye-law, giving effect to the alteration, was unanimously approved of. In limiting the privilege to members of Local Associations, the object was to protect the interests of these valuable bodies, and to prevent the increased facilities afforded for joining the Society, from possibly affecting that support to which they are so well entitled. The Directors are happy to have it in their power to report, that the measure has been properly appreciated by the farmers, and that, notwithstanding the depression which prevails in agriculture, a considerable number have already availed themselves of it.

General Shows.—The Meeting which took place at Glasgow in August last, was unquestionably the most successful and important ever held under the auspices of the Society, whether as regards the magnitude of the exhibition, or the lively interest manifested in it by all classes. It afforded a striking instance of the utility and practical good of such meetings, and of the propriety of adhering to them; at the same time it proved that the lapse of one year was not disadvantageous, but that it rather stimulated competition, and enhanced the value of the Meeting. As has already been intimated, there will be no Show for the present year, but the Directors have much pleasure in announcing that the Society will meet at Perth in 1852. It is above fifteen years since it last visited that district, which, from its agricultural importance, central situation, and facilities of access, is admirably qualified to produce an exhibition useful to the country, and creditable

to the Society. The classes of stock for which premiums will be offered have already been advertised, and are included in the Society's Book of Premiums. They will again be published, together with the list of implements, in ample time to enable intending competitors to make the requisite preparations.

Chemical Department.—In the introductory notice to the last volume, the formation of the Society's Chemical Department and the appointment of Dr Anderson were announced. During the period that has since elapsed, this establishment has been in active and beneficial operation; a commodious and thorougly appointed laboratory has been provided by Dr Anderson, with the assistance of the Society; and he has more than fulfilled his engagements in the number and efficiency of the staff of assistants maintained by him. The department is under the general supervision of a committee composed of eminent chemists and practical farmers, and comprising the Professors of Chemistry, Agriculture, Botany, Materia Medica, and Medical Jurisprudence. The work performed in the laboratory is of two descriptions—consisting, on the one hand, of subjects selected for investigation by the committee; and, on the other, of analyses and information applied for by individual members. Under the first division, many questions of a high scientific character and direct practical bearing have been remitted for Dr Anderson's consideration. Some of these, such as the analyses of the wheat soils of different districts of Scotland—the examination of certain shales, &c., in which red clover succeeded and failed—the inquiry into the economic uses of peat—and various minor investigations, have already been disposed of, and their results published in the Transactions. Others have necessarily been spread over a longer period. Among the more important of these, an investigation of turnips, grown under different circumstances, is nearly completed; while an analysis of the various substances that can be used as food for cattle—an examination of the different clovers—and other inquiries, are more or less advanced. The information supplied to individuals comprises a vast variety of subjects—such as analyses of soils, manures, waters, ores, clays, vegetable products, refuse of manufactories—in fact, every description of analysis that can be supposed to come under the attention of the agricultural chemist. Some of these, it may be noticed, have had the effect of detecting daring adulterations, which would otherwise have passed unnoticed. The Directors have, therefore, much satisfaction in reporting, that the utility and practical advantages of the chemical department have surpassed the anticipations which led to its institution, and that Dr Anderson has discharged the important duties of his office in a manner well worthy of his high position in the scientific world. They cannot, under these circumstances, but express surprise and regret that the support contributed to this department by the public should continue to be so inadequate.

It is their duty to state, that the subscription in aid of it is insufficient for the purpose, and inconsistent with what might have been looked for, in such a cause, from the agriculturists of Scotland; and it should be made known, that the exigencies of the case cannot be met by the ordinary funds of the Society, without materially interfering with its other objects. They would, therefore, express an earnest hope, that this most useful and important section of the Society's operations will not be permitted to languish, for want of that support, to which it is so well entitled, and which it is the interest of all connected with agriculture to bestow.

Veterinary College.—This establishment not only continues to maintain, but is extending, its character as one of the first seminaries of the day for the education of Veterinary Surgeons. The number of students attracted to it from all quarters is annually increasing; while the qualifications of its teachers, and the efficiency of the course of instruction pursued by them, have been well verified by the results of the recent examinations. These had for some years been in abeyance; but in 1848 the Society saw fit to re-establish them, and again to issue its veterinary diploma. To the assiduous efforts and personal supervision of Mr Burn Murdoch, as Chairman of the Society's Committee in connection with the College, are, in a great measure, to be attributed the success which has attended the examinations, and the value which is attached to the diploma. It is with regret that the Directors have to announce that gentleman's resignation, after having discharged the duties of his office, with advantage to the public and credit to the Society, during a period of sixteen years. He has been succeeded, however, by one under whose direction the College is not likely to retrograde: the Directors allude to Mr Goodsir, the eminent Professor of Anatomy in the University of Edinburgh. The recent examinations were conducted by him, aided by a large body of distinguished professional men, in a manner so searching and rigorous, in the various departments of practice and science, as to afford the public a guarantee that the students, who received the Society's diploma, are well qualified to enter on the duties of their profession. The Directors are bound gratefully to acknowledge the liberality with which so many medical men of the highest standing co-operated with Professor Goodsir in giving effect to the objects of the Society. They have only farther to report, that the diploma has been conferred on fifty veterinary surgeons during the last two years.

Monthly Meetings.—These meetings have assumed a highly important character, and now form one of the most useful sections of the Society's proceedings. Formerly reports, for which premiums had been adjudged, were read; such papers, though well fitted for the pages of the Transactions, were not so suit-

able for a public meeting, embracing, as they frequently did, details and calculations of an elaborate character. The Directors were, therefore, desirous of popularising the proceedings, and of infusing into them a greater degree of discussion; and for this purpose they invited the co-operation of the farmers, who readily entered into their views, by selecting subjects, and by coming forward to join in the discussions. The experiment has proved most successful, and the meetings have been of a highly valuable and interesting description, and have excited much notice in the agricultural world. Questions of practical bearing have been introduced; valuable information has been disseminated; and the discussions have been conducted in a manner creditable in the highest degree to the professional knowledge, scientific acquirements, and literary attainments of the Scottish farmer.

Museum.—Mr Lawson, the conservator, continues to superintend the Museum to the entire satisfaction of the Directors. The increasing numbers who avail themselves of the institution prove that it is an object of public interest and attraction. From 1st May 1849 to 1st May 1851, it was visited by 31,474 persons.

Finance.—The Directors can report more satisfactorily in reference to the pecuniary position of the Society than on some former occasions. In 1846 it was found necessary to apply £1500 of invested funds in extinction of various liabilities which had been permitted to accumulate. It has since been the object of the Board to replace this sum. For that purpose they have for some years laid aside one-third of the payments made in composition of annual subscriptions; and they have succeeded in replacing £1000 of the amount withdrawn from the capital in 1846.

Premiums.—The Directors have endeavoured so to expend the funds committed to their charge, as to give the greatest possible effect to the different objects of the Society. Experiments in the science and practice of agriculture, mechanical invention, the reclamation of waste lands, and improved arboricultural management, have all received encouragement. The seeds of cereal grains, grasses, and roots, the cultivation of green crops, dairy produce, ploughing, and the general management of the farm, continue to be the objects of premiums; while the system of cottage and garden competitions has been maintained. The greater part of the fund has, as formerly, been applied in assisting exhibitions of stock at local shows. The Directors are fully sensible of the advantages arising from the connection which is thus maintained between the Society and its numerous off-shoots, and they would willingly, were it in their power, entertain every application for assistance emanating from a local association. For this, however, the means of the Society are inadequate, more particularly at present, owing to the heavy outlay required for

the chemical department, in consequence of the insufficient support otherwise accorded to it. They have only to add, that they endeavour to exercise the patronage of the Society in this respect with the strictest impartiality.

Publications.—A desire has, on more than one occasion, been expressed by influential members of the Society, to see an alteration effected in the mode of publishing the Transactions, and it has been suggested that they might advantageously be issued at shorter intervals. This matter has received the careful consideration of the Directers; but it was found that, for the present, no change could be well effected. The proceedings of other bodies, similar to the Society, are not generally published more frequently; indeed, the papers received in competition for premiums, and available for the Transactions, are, for the most part, too voluminous for an abridged publication, while their character rarely admits of their being printed in Parts. Any alteration, such as has been proposed, would, besides, involve an outlay which the Society cannot afford, if its other important purposes are to be pursued. The agreement with Messrs Blackwood has accordingly been renewed for two years, the period requisite for the publication of another volume; their engagement being to print the Transactions along with their own Journal, on receiving a trifling allowance from the Society. As the two publications are frequently confounded, it may be proper to notice, that the first portion of each number consists of the *Journal of Agriculture*—the exclusive property of Messrs Blackwood; the *Transactions* form the second part, for which alone the Society is responsible.

Ordnance Survey.—The Society has for many years taken a lead in reference to this important national undertaking, and, through repeated applications to Government, has endeavoured to accelerate its progress. Small additions have, from time to time, been made to the means allowed for it; but these are still so incommensurate, that if not materially increased, the work cannot be completed within the present century. The attention of Parliament has at length been awakened to the subject, and a committee of the House of Commons was recently appointed to report on the state of the Scotch Survey; the attendance of the Secretary was required by the Committee, and by means of his evidence the views and wishes of the Society have been fully laid before it. The Directors lately presented a memorial to the Lords of the Treasury, praying for a reduction of the size in which the maps are being engraved and published. While they recommend the prosecution of the Survey on a scale of six inches to a mile, and the preparation of drawings on that scale to be deposited with Government for reference, they are convinced, after very mature inquiry, that the engraved maps will better answer all practical and scientific ends if reduced to one inch to a mile. This is established by the

experience of Ireland, where the six-inch maps have proved inoperative for most useful purposes. The proposed reduction will, besides, enable the Ordnance to shade the maps, which is an essential feature of the work, while it will create a very considerable pecuniary saving, and thereby accelerate the completion of the Survey.

HONORARY SECRETARY.—This office was created by the Charter of 1834; and the late Mr Macdonald of Staffa, who had for many years acted as Secretary, was the first who filled it. He was followed in 1839 by Sir Neil Menzies, and on his death in 1844 Mr Hope Johnstone was chosen to succeed him. It was with great regret that the Directors received that gentleman's resignation last year, knowing, as they did, how well he was qualified for the office, and the interest taken by him in the Society. In looking for a successor, they had no hesitation in proposing Sir John Stuart Forbes, who had for fifteen years acted as the Treasurer of the Society, and had on all occasions approved himself its consistent and firm supporter. There has been no other change among the permanent officers, from all of whom the Directors continue to receive the best support and assistance. To the Secretary, Mr Hall Maxwell, the Board have to acknowledge their special obligations, and to record in particular their sense of the zeal and ability shown by him in planning and conducting the admirable arrangements for the great exhibition of last year. The general establishment for 1851 is as follows:—

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HIS GRACE THE DUKE OF ROXBURGHE, K. T.

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THE EARL OF MANSFIELD.
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Argyll Naval Fund,	Alexander Lamont of Knockdow.
Veterinary College,	Professor Goodsir.

MUSEUM.

Lord Berriedale, *Chairman.*
Robert Graham of Redgorton, *Deputy-Chairman.*
Charles Lawson, *Conservator.* James Slight, *Curator of Models.*
Edward J. Ravenscroft, *Assistant-Conservator.*

MONTHLY MEETINGS.

The Earl of Roseberry, *Chairman.*
Sir John M'Neill, G.C.B.; Professor Low; W. B. Callander of Prestonhall; and David Milne of Milnegraden, *Deputy-Chairmen.*

ON PUERPERAL RED WATER IN COWS.

By Mr M. Cuming, V.S. Ellon, Aberdeenshire.

[Premium, Ten Sovereigns.]

In offering the following contribution to the pathology of the disease known as "red water," it seems necessary to define accurately the extent and limits within which the investigations it contains are confined. Under the generic name of "red water" have been described, by various practical authors, diseases essentially differing in their nature, their causes, and commonly in their terminations; in fact, agreeing only in the colour of the urine voided during their continuance. In consequence of this, much obscurity has involved the nature not only of one, but of all the diseases so treated of. The attempt to unite, under one description, things widely different, has caused some of those whose province it has been to collate and generalise upon the information of others, rather than to observe for themselves, to complicate and confound those different ailments which agree only in this one symptom; and hence to confuse instead of to elucidate their individual pathology. In trying to indicate a disease agreeing more or less with all the descriptions given, they have missed their aim, and imagined one agreeing with none.

In the hope of avoiding this error, and believing that an accurate delineation and satisfactory account of one form of disease tends more to the improvement of veterinary science than a much wider range of inquiry of a more general nature, the following remarks are designed solely to refer to that form of *red water* known to occur in milk cows, and which generally follows within a short time after their calving. This disease, from its constant connection with the parturition of the animal, I shall take the liberty, for distinction's sake, of calling puerperal red water. The other ailments that have been occasionally described under the same name—viz., red water occurring in young or male animals, being less common, and arising from causes either of an accidental or partial prevalence—I shall not allude to, farther than

is necessary to make plain the difference between them and the disease under notice.

History of the Disease.—Puerperal red water (known also as "black water," "bloody urine," &c.) is but of modern origin. So far as I am aware, it is but coeval, in this country, with the introduction of turnip husbandry, and seems to have prevailed to the greatest extent, and with the most fatal severity, in the period succeeding the general introduction of this root as a field crop, and preceding the improvements that have taken place in the breeds of cattle consequent upon the distribution over the country of the Durham and other fast-growing varieties. Twenty years ago the writer of this recollects conversing with more than one aged farmer who described to him the introduction of turnip culture into Aberdeen and Banff shires, and generally in the north of Scotland; and also mentioned the occurrence of red water in cows after calving, during winter and spring, as one of the consequences of the use of this root. At the present time, throughout the same district, (and it is to this only that the following remarks apply,) the disease has become almost unknown on those farms where improved stock are kept; while, in many of the less forward parts of the country, where the native breeds still prevail, it is of common enough occurrence. In the experience of the last five years I have found but two cases of red water (and these of the mildest sort) happening among cows of the short-horn or cross breeds, although during the greater part of that time I have attended upon a number of farms where this sort is almost exclusively kept. On the other hand, I have met with more than twenty cases belonging to crofters or cottagers, who keep only two or three cows, and these commonly of the old native kind. Red water, then, in the present state of agriculture in the north of Scotland, is essentially a disease attacking the poor man's cow; and, to be seen and studied, requires a practice extending into the less favourably situated parts of the country. On large farms, where good stock is well kept, and in towns' dairies, where artificial food is used to supplement the supply of turnips, it is seldom now seen.

In tracing the recorded history of red water in our veterinary literature, it should be borne in mind that, in addition to the puerperal form of the disease, we have mixed up with it descriptions of red water arising from certain peculiarities of pasture, and hence attacking indiscriminately whatever kind of animal is put upon it; red water produced by the fatigue of driving the animals from one place to another; red water produced in summer by excessive and protracted drought, and affecting all kinds of cattle exposed to it; red water arising from blows, hurts, or strains; and red water a consequence of inflamed kidneys.—(*Vide* Essays on red water in *Quarterly Journal of Agriculture;* article "red water," Farmers' Series, *Library of Useful Knowledge;* &c.)

In any attempt to bring under one description diseases of such various origin, it is evident that the pathology must be far from satisfactory. White, the earliest author I have consulted on the subject, sets red water down as a "relaxation of the kidneys, which, instead of admitting urine only to pass through them, yield or give way when there is any unusual determination of blood to them, and suffer blood also to pass as well as urine." Webb, a writer of some popularity in the north, and whose "Farmer's Guide" is in almost every farmer's library north of the Grampians, holds something like the same opinion. "This disease," says he, "affects black cattle at all ages, and has proved very destructive to dairy stock for some years past. Cows, when newly calved, are very liable to it; and if early means are not used to check its progress, it commonly terminates in death. There are various opinions amongst cattle-doctors concerning the cause of this disease, but no one has yet led to any satisfactory or evident proof. I am fully persuaded that the malady does not proceed from any one cause in particular, but from a combination of causes which may affect the system, and produce unusual secretion of serum or lymph; and from whatever cause it may happen, if a redundancy of this matter exists within the system, it will obstruct the circulation; and the effects it produces are either a stagnation or a rupture of the small blood-vessels; and if the blood passes off with the urine, it constitutes the disease or the term of red water."

Mr Thomson, one of the writers, and by far the ablest on red water, for the Highland Society's Premium in 1830, makes the disease to be one of the liver, and the colour of the urine to be owing to bile taken up by the absorbents and passed into the blood.

Mr Youatt, in his work on cattle, adopts something like the same views; only, to account for the variety of symptoms and appearances which he found described, he supposes an acute and a chronic form of the disease.

In the *Veterinarian*, since the date of the work on cattle, several veterinary surgeons, both English and Scotch, have contributed cases of, or articles on, red water; and many of their descriptions of symptoms and *post-mortem* appearances are remarkably true to nature; but in none of them that I have seen is a satisfactory rationale of the disease given; nor, with one exception, is there any attempt made to clear up what one would have thought should have been the first point of inquiry—viz., the cause of discolouration in the urine. The various opinions as to the primary seat of the disease seem to oscillate between attributing it to disorder of the liver and of the other digestive organs, particularly the third stomach; while some, again, connect it with derangement of the functions of the uterus; but no uniformity of appearances after

death has been observed in the state of these organs, nor has any satisfactory connection been traced between the signs of disease seen in them, either during life or after death, and the colour and other conditions of the urine.

Such is a brief general outline of the present state of our veterinary literature in regard to red water. References of a more special kind will be made to some portions of it when describing the symptoms and *post-mortem* appearances of the disease.

Symptoms.—The following are the symptoms as noted at the time in a well-marked case of the disease:—Nov. 6, 1847: cow a week calved; had been giving milk abundantly, but secretion now gone; great general debility; pulse 100 per minute, and weak if felt at the extremities, but with strong bounding action of the heart; extremities cold; mucous membranes blanched; bowels constipated; appetite and rumination gone; urine dark red or claret colour; bleeding was tried to the extent of about a quart, but had to be stopped in consequence of faintness coming on; blood thick, but not coagulating firmly, and of a dark claret hue, as if *loaded* with colouring matter. A portion of urine, examined under a powerful microscope, presented no blood globules nor organised matter, with the exception of some fragmentary-looking shreds, like broken-down epithelial cells; it was slightly acid, showed floculent-like coagula on addition of the strong acids and solution of hyd.-bichlor.; evaporated to dryness, it left 2.7 per cent of dry matter. This animal died. The treatment and *post-mortem* appearances will be noticed each in its proper place.

In another case, occurring on the 9th of the same month, I find the following noted:—Cow, when first seen, rather weak; pulse 70 to 80 per minute, pretty strong; extremities cold; appetite and rumination suspended; mucous membranes blanched; urine copious, very dark claret in colour; milk gone; bowels constipated; urine, specific gravity 1024·5, with the same chemical reactions, and about the same quantity of dry matter as in the former case. This animal recovered. The treatment will be given under that head.

Instead of giving a further detail of cases, which would only be a repetition of the same symptoms, the following extracts, from a few of the best narrated cases in the *Veterinarian*, will show the coincidence between the appearances of the disease, as occurring in different localities, and noted by different observers. The first I shall notice is by Mr Tait, V.S., Portsoy, detailed in vol. vi. of the *Veterinarian*, page 302, June 1833:—"Some time ago," he says, "I was requested to see a cow which I found affected with red water, and which had been ill for two days previously. She had been off her feeding from the time she had been observed to

be affected; and at the time I saw her, she was lying, and hardly able to rise, with extremities cold, and rumination completely suspended; breathing much hurried, and pulse very much accelerated, beating 100 per minute; even standing a few yards from her, you could hear the heart beating as distinctly as if your ear had been laid against her side."

The next extract is by Mr Steel, V.S., Biggar, *Veterinarian*, vol. vii., page 362, July 1834. Writing on the subject generally, he says—"When the disease is coming on, the cow seems rather dull; then she is observed to pass urine of a very high colour; it soon approaches to a perfect red, and sometimes it becomes black; the pulse is 80, 90, or 100 and upwards, having a particularly full beat; the back is always a little raised, and there is an inclination to strain considerably in the evacuation of the fæces; she voids her urine frequently, but in a few cases the urine and fæces are retained altogether; the eyes are sunk; the abdomen tender; and at times the cow is afraid to put the parts into action. . . . The disease sometimes commences with diarrhœa, when, if a purgative is given, and a little laxative medicine for a few days afterwards, she will soon get well; but if she is then neglected, the costiveness becomes extreme; and when the patient dies, the manyplus is found dry and hard as a stone."

The next case I shall here notice is that of a cow, the urine of which was analysed at the London Veterinary College in January 1840. The history of it is this:—"The cow was about twelve years old; had calved twelve days; and nothing was perceived to be the matter until Saturday last," (the description is written on the 3d of December 1839,) "when I was informed that she was dull and would not feed. I sent her an aperient draught, and on Sunday morning her owner came and informed me that she was worse, and that her water was the colour of porter. I saw her about 11 o'clock; she was lying down; her ears and extremities were chilly, but not cold; her breathing quite natural, but she had a weak and frequent pulse, from 70 to 80. The muzzle was dry, the saliva hanging from the mouth; and when made to rise, she could hardly walk, but staggered as if she would fall. I found, on inquiry, that on the Thursday night she had been scouring. Her dung was now rather firmer than natural."

The last extract I shall make on this part of the subject, is from a paper by Mr M'Gillivray, V.S., Huntly, read before the Edinburgh Veterinary Medical Association, November 27, 1844, and published in the *Veterinarian* of the following year. In describing the symptoms, he says—"The first observed is, generally, looseness; then costiveness appears, accompanied by redness or a brown tinge of the urine, or perhaps it is brown from the first. Generally there is a symptomatic fever, accompanied by rigors,

difficult breathing, and the horns, ears, and extremities cold. Sometimes the mouth is hot; the animal appears as if it were drawn together between the last rib and the anterior spines of the ileum; and along the greater part of the spine there is a feeling of coldness. The heart beats strongly, and may be heard at a little distance. Often the fæces are very slightly changed in consistence; but generally, or in all cases, they are darker in colour. For a while after the attack, the cow feeds almost as well as usual, ruminating a little; but the milk is diminished in quantity, and bad in colour and taste. When the appetite fails, it is generally the food most desired in health that is first rejected, such as turnips or potatoes. During this stage, hay or sweet oat-straw will be preferred, but eaten in very small quantities, and in a careless manner. The urine is ejected frequently with considerable force; has a high temperature, and gradually gets darker in colour. The animal becomes exceedingly weak; the back is bowed, and the pulse quick. I have felt it from 75 to 83, very irregular, often feeble, scarcely to be felt at the jaw; tender loins, and the animal yielding under pressure. As the disease advances, the head becomes pendulous, the mouth supported on the crib; the ears cold; great disinclination to move; or if down, unable to rise."

In addition to such symptoms, there is one of a premonitory kind, which I do not recollect to have seen noticed by any writer, but have found invariably to be present, viz., an unnaturally abundant secretion of milk after calving, previous to the appearing of the disease. The milk is also particularly disposed to froth in the pail when being drawn, and sometimes has a red sediment at bottom on standing. So constant is the connection between this and red water following it, that I have, in a number of cases, known persons in charge of the dairy to predict that a particular cow would have red water, several days before any other symptom made its appearance.

The disease commonly shows itself from a week to a fortnight after the cow's calving. If beyond a fortnight, the case is generally mild and manageable; if occurring earlier, it is more severe. In the case quoted from the *Veterinarian*, the urine of which was analysed at the London College, the cow was twelve days calved; and Mr Steel, in the paper also quoted from, asks—"How is it to be explained that this disease should come on exactly two weeks after calving?" Red water, also, in every case I have met with of the puerperal form, has come on while the cow was feeding on turnips; and, in addition, liberally supplied with them.

Before dismissing the detail of symptoms, I would again bring under notice a few of the more obvious, in the order in which they stand connected in the course of the disease:—The excessive flow of milk, of course derived immediately by secretion from the blood; the copious discharge of colouring matter in the urine,

which I will by-and-by show to be also a constituent of the blood; the strong palpitating action of the heart; the blanched appearance of the mucous membranes; and the general coldness and other signs of sinking of the system: all point to a diminished quantity and deteriorated quality of the circulating fluid, and aid us materially to a true explanation of the nature of the disease.

Post-mortem appearances.—In the case, the symptoms of which are first described, the general appearances after death denoted it to have come about by anemia. The sub-cutaneous tissue, on removal of the skin, looked as white as if the animal had been bled to death; the internal abdominal viscera equally blanched and free of blood; not a pint of blood in the whole of the large vessels; the heart also nearly empty; the purgative medicine given had got nearly through the bowels; and, with the exception of the third stomach, which was much dried up, the alimentary canal was natural; the kidneys, liver, and uterus were healthy, as were all the other internal organs, except the heart, on which there were here and there irregularly-marked spots of echymoses, both externally and internally.

This description applies generally to every case I have met with. Sometimes depending portions of one or both kidneys, or of the liver, assume a dark leaden hue, and feel softened to the touch. Spots of the same colour are also sometimes seen on the intestines, especially such portions as lie in contact with the liver or kidneys. The third stomach is almost always fuller than natural, and the contents much dried; the matter in the other stomachs natural in appearance, and the bowels empty, with the exception of a little blackish mucus or bile. The gall bladder is always full of bile, as it is in every instance where death has been preceded by a period of inaction in the bowels. The uterus I have never seen in the least unhealthy, nor presenting any appearance different from what is ordinarily to be found at the same period after calving. The flesh and fat are always free from blood, but often yellow, yet not more so than we see in lean cow-beef. I have always observed traces of irritation, or *overwork*—if I may be allowed the expression—about the heart.

Mr Steel, in the paper already quoted from, says—"I have had the opportunity of seeing one only after death. The uterus had spots of inflammation; the gall bladder full of a fluid similar to the urine which the cow was passing; the manyplus was rather hard and dry; the kidneys had a relaxed bleached-like appearance. I could observe nothing more wrong."

In another of the cases quoted, and to which particular reference has already been made, in consequence of the analysis of the urine to be hereafter noticed, the kidneys appeared "externally to be in their perfect and natural state." On laying them

open, "the cortical substance was rather darker than usual, and this discolouration was also particularly marked in the tubular, or what is usually designated the medullary portion. The tubes which made up this portion of the kidney were also larger than natural, and they appeared as if dilated by the viscidity of the fluid which flowed into the pelvis. This cavity was also much enlarged; but it did not appear otherwise to be in the least affected, or to have suffered from inflammatory action. The mucous lining of the ureters was likewise healthy; and on tracing the ureter to its termination in the bladder, it was found to be in a normal state. On laying open the bladder, the lining membrane of that viscus was seen to be of an unusually dark hue, and it contained a considerable portion of fluid similar to that which had been already taken out; but there were in this organ no marks of inflammation whatever. On examination of a portion of the liver, there were evident marks of diseased action. The parenchymatous structure was almost destroyed, and assumed that clayey hue so often presented in chronic disease of that viscus. It was easily broken down on pressure being applied; and the granulatory formation presented itself on cutting it open, although the liver itself was completely disorganised. It appeared like one mass of clayey matter almost in a state of disintegration.*

Mr M'Gillivray in his paper gives the following as *post-mortem appearances*—"The rectum generally contains indurated fæces, often covered with dark-coloured slime; the liver is darker in colour than usual, its structure is tender; the gall bladder full of thick bile, black in colour, and aptly compared to molasses: sometimes there is an appearance of oil mixed with and covering it. The thoracic viscera are often tolerably healthy, but at times inflamed, and generally has the same morbid colour common to the abdominal viscera. Commonly the contents of the lacteals and thoracic duct are found of a dirty red or brown colour: thus the whole of the secretions may be said to present more or less of a morbid appearance; the third stomach obstructed, the contents hard, matted, and often apparently not properly masticated; the kidneys, ureters, bladder very dark in colour; in the majority of cases, a quantity of partially putrid fluid in the uterus, which of itself is always inflamed more or less, but generally in patches."

I have preferred giving the above outline of symptoms and post-mortem appearances from the experience of others, to offering only the fruits of my own observation, for the two following reasons: First, because being about to propose a somewhat novel theory of the disease, it seemed necessary to confirm what I had myself seen

* It must be mentioned that this examination was made eight or ten days after the death of the animal.

by the statements of others, lest I should have been suspected of stating only such facts as favoured my own views; and secondly, because while I think there is sufficient uniformity—I may say identity—among the points observed, to show that it is one and the same disease that is described in all, although occurring at different times and in different localities, yet there does not appear sufficient data to implicate any particular organ, or set of organs, as the seat of the malady, nor light enough to elucidate its true character. Our additional information we must look for in a more careful examination of the urine than appears to have been hitherto made.

Composition of the urine, and cause of its redness.—I have already, in sketching the history of the disease, alluded to the different opinions held as to the cause of the colour of the water; some making the colouring matter to be blood; others bile; a third party, suppressed lochia or after-cleansing; and a fourth, something not well understood, depending upon indigestion or derangement of the stomach or bowels. It speaks but little for the progress of veterinarians in the art of inductive reasoning, that so much speculation should have been hazarded in a matter so easily subjected to experimental proof. The only recorded attempt that I have met with to elucidate the nature of this disease by a chemical analysis of the urine, is in vol. xiii. of *The Veterinarian*, No. 90, June 1840. The analysis was made in the previous month of January at the London Veterinary College, by Mr Hughs, at that time a student there. I have already given the symptoms and appearances of this case, in so far as they are of importance for the purpose of comparison. The results of his examination, as given in a tabular form, are as follows:—"Relative proportion of the different substances in an imperial pint of urine,—

Albumen and other animal matter,	112.50
Urea with fatty colouring matter,	22.50
Sulphate of soda,	10.00
Phosphate of soda,	20.00
Muriate of soda,	25.00
Muriate of lime,	2.50
Oxide of iron,	5.00
Lactate or acetate of soda,	10.00
Silica, phosphate of magnesia, with lactate or acetate of lime or magnesia,	10.00
Loss,	7.50
	225.00 grs."

I need not extract at length the process of analysis by which Mr Hughs arrived at the above conclusions. Those interested in the inquiry will find it detailed at some length in his own words. There are, however, in his statement several inaccuracies which throw a shade of doubt upon his results, and which therefore

require in passing to be pointed out. For instance, in one place he speaks of a *precipitate* of *sulphate of soda* being thrown down; and again, in another he makes a portion of ash, weighing 1.25 grains, after having its soluble part dissolved out, to yield an insoluble residue of 5 grains. These discrepancies, although apparently of small moment in themselves, shake our confidence in the more important results declared. But there are more serious objections to the value of Mr Hughs' analysis than these. A large proportion of the dry organic or animal matter of the urine is set down as albumen, on the simple result of its coagulating when boiled. But many other animal substances, as well as albumen, coagulate at the boiling temperature; and he might have just as well inferred one as another. Nor is this all: the mode of subjecting, as he did, the entire mass of the urine to one form of examination, instead of isolating the colouring matter, and subjecting it and the other constituents of the fluid to separate determination, entirely nullifies the value of the analysis as a means of ascertaining the cause of discolouration. I could have wished that this analysis had been more trustworthy than it is; but finding it with these evident errors on its face, I thought it necessary to point them out, before availing myself of what I believe to be its truths. In order to afford an easier means of comparison, I have calculated the figures given in Mr Hughs' table, into the proportion they bear in 1000 parts, grouping the constituents also together in such manner as seems most to simplify their consideration. They will be found thus set down in the table given for the comparison of results.

Having made an analysis of red water urine previous to meeting with Mr Hughs' paper, I was naturally anxious to compare the conclusions I had come to with something authentic on the healthy composition of the same fluid. The only analyses of cows' urine I could lay my hand on at the time, were those of Boussingault and of Sprengel, as given in *Johnston's Agricultural Chemistry*. The discrepancy between these two authorities was so great, however, and the difference so obvious between the results respectively obtained by them and those I had by repeated experiment found to apply to animals of the kind, and on the keep common in this country, that I was obliged to abandon the hope of deriving advantage from the comparison, and to set about an analysis of healthy urine for myself. In doing this, I adopted the views advocated by Simon in his *Animal Chemistry*, that the greater the number of analyses made after one method, so as to admit of close comparison between them, the better, even although each individual examination should refer only to a limited number of points.

In making an analysis of healthy cows' urine, I had two objects constantly in view: the first, to get a satisfactory estimate of its

composition in the most simple form possible, and by a process the least complex; the second, to bring out with accuracy those points essential to a comparison of the healthy with diseased forms of the secretion, especially with that known as "red water." The points, therefore, sought to be ascertained were—1st, Specific gravity, and other general characters; 2d, Proportion of water; 3d, Proportion of dry organic or combustible matter; 4th, Amount of inorganic matter soluble in water, with qualitative determination of constituents; 5th, Amount of inorganic matter soluble only in acids, with determination of constituents; and 6th, Determination of the presence and quantity of iron.

The mode of analysis was as follows:—First, a weighed quantity—say 500 or 1000 grains of the liquid—was evaporated in a porcelain basin over a water bath, till it ceased to lose weight. The loss here was water, with a minute quantity of volatile animal matter. The dry residue was now burned in a crucible, till reduced to a white ash: the loss in this part of the process was dry organic matter, and salts of ammonia if present. The whole of the ash was boiled for a few minutes over a spirit lamp, and in distilled water, and then thrown on a previously dried and weighed filter, and the filter paper and its adherent contents again dried and weighed: the loss in this consisted of alkaline salts. The insoluble residue on the filter was next boiled in a solution of muriatic acid till entirely dissolved: this solution contained the earthy matter of the urine and the iron. The alkaline solution was divided into two equal portions, the one of which was tested for the acids, the other for the bases. The acid solution was treated somewhat differently. The plan adopted for separation of the iron from the phosphates, was to add tartaric acid to the muriatic acid solution, which prevents the precipitation of iron by ammonia; then to throw down the earthy phosphates by boiling with ammonia, and carbonate and muriate of ammonia, to filter off the clear fluid, and throw down the iron by hydro-sulphuret of ammonia; afterwards the solution to be still further tested for magnesia by phosphate of soda. An obvious reason exists for so much stress being laid on the determination of the presence of iron in the ash of the urine. Iron is almost the sole mineral constituent of hæmatine, the colouring substance of the blood. Its presence, therefore, in the ash of the urine would be evidence presumptive that the colour of the secretion was in some way derived from the colouring matter of the blood; but to render the proof positive, it was necessary to ascertain that the urine itself in its healthy state did not contain iron; as, if it did so, its presence in the diseased fluid went for nothing, unless the analysis of the colouring matter was kept distinct from that of the other parts of the urine. In the analysis made by Mr Hughs, this source of error, not being guarded

against, formed a most important damaging element. Another reason for seeking certain information about the existence of iron in cows' urine was, that I had somewhere seen it denied. The exact authority I cannot at present lay my hand upon; but, to the best of my recollection, it was some of the more eminent of the continental physiological chemists. In every instance, however, that I have examined the urine of the cow or ox, whether healthy or diseased, I have found distinct evidence of the presence of iron.

Analysis of healthy cows' urine, made Nov. 1848.—Cow three months in calf; feeding on turnips and hay, and giving three to four quarts of milk daily; specific gravity 1024, bright amber colour, alkaline reaction, brisk effervescence with nitric acid—

Water and indeterminate animal matter volatile at 212° .	963·25
Dry animal matter and salts of ammonia, (combustible,) .	12·85
Inorganic matter soluble in water, being alkaline chlorides, sulphates, phosphates, and carbonates, . . .	21·30
Inorganic matter soluble in acid, (hydrochloric,) being earthy phosphates, sulphates, and iron, . . .	2·60
	1000·00

Of the last-named, ·56 was iron, indicating ·80 of the peroxide, or ·08 per cent, or 3·34 per cent of the inorganic matter; but it is doubtful if a small portion of earthy phosphate was not thrown down along with the iron. From the above very notable quantity of iron being found in the ash of healthy cows' urine, it was obvious that, to obtain a satisfactory analysis of *red water*, a different method required to be adopted. This consisted in the isolation of the colouring matter from the rest of the urine, which was to be effected by boiling and filtering, and the examination of the inorganic constituents of each separately. An analysis, with this view, was made in the same month and year as the above. The following are the results:—

Analysis of red water urine, Nov. 1848.—Urine from cow four or five days ill. Had been getting considerable quantities of Epsom salts and ginger; bowels open; pulse 140 per minute; bounding or palpitating action of heart very distinct; animal very weak; appetite a little improved; urine of the same colour as venous blood; gave no sediment, even after standing a number of days; effervesced on addition of the mineral acids, with separation of colouring matter, into a floculent, slowly-subsiding precipitate. Specific gravity 1025. One thousand grains boiled gave, on cooling, a precipitate of a dirty grey colour, resembling effete yeast, which, after filtering and drying on the water-bath, left 13.28 grains of dry dark brown matter, having a black shining fracture, and without any tendency to deliquesce even in a damp atmosphere. It was soluble to some extent, but without loss of colour, in boiling sulphuric acid and

boiling caustic potass. Caustic potass, precipitated from the sulphuric acid solution, the greater portion of the matter dissolved, without loss of colour; and the reverse experiment with sulphuric acid, in the potass solution, gave a colourless precipitate. The latter experiments were with colouring matter from a separate portion of urine. The entire dry colouring matter derived from 1000 grains of urine was ignited in a crucible in the open fire. It burned with a bright yellow flame, and not much smoke, giving 1.72 per cent of its weight (being .22 in 1000 parts of urine) of a red ash, entirely soluble in hydrochloric acid: the solution striking a deep blue with ferrocyanide of potassium, and a black with hydro-sulphuret of ammonia; and the filtered fluid yielding still further, on the addition of phosphate of soda, a slight white precipitate, indicating a trace of magnesia. After precipitation of the colouring matter by boiling and filtering, the urine presented the usual amber colour of the healthy fluid, and yielded on analysis, after the former mentioned method, as follows:—

Water and indeterminate animal matter, volatile at 212°,		962.44
Dry colouring matter, consisting of combustible animal matter,	13.06	
Inorganic matter, chiefly iron with a trace of magnesia,	.22	
		13.28
Dry animal matter in urine, with salts of ammonia,		14.43
Inorganic matter in urine, soluble in water, being alkaline chlorides, sulphates, phosphates, and carbonates,		9.10
Inorganic matter, soluble in acid, (hydrochloric,) being earthy phosphates,	.32	
Carbonate of magnesia,	.39	
Iron, (combination uncertain,)	.04	
		.75
		1000.00

The value of this analysis, both actual and comparative, will be seen on looking to the determination separately of the composition of the colouring matter. I have already mentioned the fact, microscopically demonstrated, that the urine in red water did not contain distinctly-formed blood globules, and that the only trace of organised matter in it was of a fragmentary or broken-down form. This is strongly confirmed, if confirmation were needed, by the appearance the colouring matter presents when collecting on being boiled in a glass tube. It is not in the least like the gradual thickening of albuminous urine, but is simply a collection together of floculent shreddy matter, previously floating in the fluid. On the other hand, the ash of the colouring matter being entirely iron, shows that it is hæmatine in some form to which the colour is due. The only conclusion, therefore, is, that the colour of the urine in red water is produced by the presence of the colouring matter of the blood in an effete or worn-out con-

dition. The way in which this condition is brought about, and the value of knowing it, will be pointed out by-and-by.

Another analysis of red water urine, in confirmation of the above, was made, in the beginning of June 1849, by Mr Deuchars, V.S., at that time my assistant. It was made under my direction, and after the same method as the last. The urine was a mixed sample from two cases, both of them severe, but both recovered. The results differed but slightly from the former. They were as follows:—

Water, and indeterminate animal matter, volatile at 212°, .		960.29
Dry colouring matter, consisting of combustible animal matter, ...	16.37	
Inorganic matter, chiefly oxide of iron, with a trace of phosphate of iron and magnesia, . . .	1.05	
		17.42
Dry animal matter in urine, with salts of ammonia, .		9.00
Inorganic matter in urine, soluble in water, being alkaline carbonates, sulphates, and chlorides, ...		12.11
Inorganic matter, soluble in acid, being earthy phosphates and sulphates, ...		.95
Phosphate of iron and magnesia, ...		.23
		1000.00

The correspondence between these analyses is so close as to be a proof of both being correct, and guarantee that they afford a trustworthy estimate, as far as they go, of the composition of the fluid under consideration. To afford at one view a satisfactory comparison of the different analyses that have been given, the following table may be useful:—

COMPARISON OF ANALYSES.

	Analysis of healthy urine —original. No. 1.	Analysis of red water urine—Mr Hughs. No. 2.	Analyses of red water urine —original. No. 3.	No. 4.
Water and indeterminate matter,	963.25	974.74	962.44	960.29
Dry colouring matter, . . .	—	—	13.28	17.42
Dry animal matter in urine, .	12 85	15.15	14.43	9.00
Inorganic matter soluble in water,	21.30	7.27	9.10	12.11
Inorganic matter soluble in acid,	2.60	2.84	0.75	1.18
	1000.00	1000.00	1000.00	1000.00

The above comparison affords us several points worthy of our attention. The most remarkable is the great diminution of inorganic matter, both alkaline and earthy, from the healthy

standard. Of the three analyses of red water urine, the average gives only 11.05 of inorganic matter in 1000 parts; while in the healthy fluid we have 23.90 parts, or something more than double. Neither is the healthy proportion, as found in this instance, likely to be high, it being only about half the quantity stated by Boussingault. We will by-and-by see the cause of this decrease, and its application to the treatment of the disease. We are now in a condition to consider

The nature of the disease.—In order to arrive at a satisfactory conclusion on this, the most important point of our inquiry, let us bring together the leading facts already brought out. The disease is specifically connected with the state of the cow immediately after calving, and when fed on turnips; it is preceded by an abundant flow of milk; the blood becomes loaded with colouring matter; the colour of the urine is due to this colouring matter in a worn-out or decomposed state; the saline constituents of the urine are much reduced in quantity; the tendency to death is by *anemia* or sinking; the strong bounding action of the heart is the palpitation of weakness, not the overaction of inflammation; and after death the body is found almost drained of blood, while during life the mucous membranes were pale and blanched. The variations of the lesions found after death, and their general insufficiency to account for the event on the score of local disease, send us somewhere else to look for a cause; and the often critical discharge of black fetid fæces, by which the disease is ushered in, seems evidently an attempt of nature to throw it off by the liver or bowels, previous to the kidneys taking on the same function. All these circumstances conjoined tell us plainly that the ailment is primarily in the blood, and due to an unnatural and unhealthy overloading of that fluid with colouring matter. In order to see how this is brought about, we require to compare the chemical composition of blood and of milk. The proximate analysis of cows' blood gives us the four following constituents, viz:—

Serum (containing 61·50 of Albumen,)	841·97
Colouring matter and adherent fat,	148·55
Fibrine,	4·95
Saline matter of entire blood,	4·53
	1000·00

This analysis was made in September 1848; the blood was from a cow affected with rheumatic pericarditis, one of the few inflammatory forms of disease to which cows are subject. The proportion of fibrine is, I think, somewhat higher than may be found commonly to exist; a fact due to the nature of the animal's complaint: in other respects, I believe it affords a faithful estimate of the general composition of cow's blood. The process of analysis I need not detail, nor does the proportion of the consti-

tuents materially affect our present inquiry, which extends only to a comparison of the proximate components of the two fluids.

The following may be accepted as an authentic statement of the composition of milk. It is that of the average of a number of analyses given by Dr Playfair in his essay on milk:—

Composition of Milk.

Water,	870
Butter,	46
Casein or cheese,	40
Sugar of milk,	38
Saline matter,	6
	1000

This applies to milk as ordinarily drawn from the cow. The colostrum, or milk yielded for a short time immediately after calving, is, however, a good deal different, especially in containing albumen, the same in composition as the albumen of the blood, instead of casein. The following analysis of colostrum is by Boussingault:—

Composition of Colostrum, or First Milk.

Water,	784
Butter,	26
Albumen,	151
Sugar,	36
Saline matter,	3
	1000

The most prominent difference between these two tables is the large proportion of albumen found, instead of the ordinary casein, in the milk of the cow after calving. The effect of this in certain circumstances will be found not unimportant in the production of red water. Two additional points still need to be stated—First, that the azotized matter of the blood, the albumen and fibrine, are identical in composition with the azotized matter of milk, the casein, and also the albumen of the colostrum. The following table, from Mulder, shows this more clearly:—

		Albumen.		
	Fibrine.	From Egg.	From Serum of Blood.	Casein.
Carbon,	54·56	54·58	54·84	54·94
Hydrogen,	6·90	7·01	7·09	7·15
Nitrogen,	15·72	15·70	15·83	15 80
Oxygen, with a trace of sulphur and phosphorus,	22·82	22·81	22·24	22 09
	100·00	100·10	100·00	100 98

The second point to be noticed is, that the milk is eliminated immediately from the blood by the secreting action of the udder.

Let us next see how the constituents of the one fluid are represented by those of the other. We find

In Blood—	*In Milk—*
Water	Water
Fat	Fat
Saline matter	Saline matter
Albumen and fibrin	Casein
Colouring matter	Sugar

From this comparison it appears that, while we have four of the elements of the one fluid identically represented in the other—viz., the water, the azotized matter, the fatty matter, and the salts—we have in each an odd constituent, of which the other has no representative. Sugar, as far as I am aware, has never in any appreciable quantity been found in the blood of the cow, although, from the fact of its being so abundantly yielded in the secretion of milk, there can be little doubt of its being there *in transitu.* The quantity at any one time in the blood being inappreciably small, leads to the inference of a rapid passage from the food to the udder. On the other hand, we find in the blood a large mass of colouring matter, for which, from its composition, there is no outlet by the udder, it having no representative in the milk. We may therefore state the comparison thus:—In the blood, colouring matter; in the milk, none. In the milk, sugar; in the blood, none.

With these facts before us, we can at a glance see how red water is produced. Immediately after parturition the lactiferous organs of the cow are in a highly excitable state. If now we supply food comparatively deficient in azotized and saline matter, but rich in sugar, the consequence is, that the sugar, not being a constituent of the blood, has no abiding place in that fluid, but tends to an immediate and abundant increase of milk. But sugar cannot alone yield milk, and a drain is made upon the blood for the other elements required. The serum of the blood is wasted to supply the watery part of the milk. The albumen and fibrin are wasted to supply the albumen so abundant in the colostrum, and the casein of the milk. The saline matter is wasted to give salts, and the fat to form butter; and all that is left over after this unnatural exhaustion, is a reduced entire quantity of blood in the system, loaded with a greatly increased proportion of colouring matter. The exorbitant flow of milk preceding the disease—the anemic condition of the animal during life—the small quantity of blood found in the body when death supervenes, and its deeply augmented colour, are all indubitable proofs on this point, and every other phase and feature of the malady corresponds to the same view.

The cow with the large supply of blood diverted to the udder, which was previously directed to the uterus for the support of the young animal contained in it, for a time bears the draught upon

her vital powers without inconvenience; and if supplied with plenty of food capable of yielding *all* the elements of the waste going on, retains her health. But if the balance be destroyed by giving one element of the milk in abundance, and limiting the rest, as in a too liberal feeding with turnips, then the proportions of the component parts of the blood soon undergo alteration, and debility and derangement of health must follow. Nature, always ready to restore the balance of deranged function, at first tries to relieve the blood of its superabundance of colouring matter, by a copious discharge from the bowels; and this, as I have already stated, sometimes proves critical, and the evil begins to abate. At other times—and these the most frequent, from the cause being still in operation—the discharge by the bowels fails to have the desired effect, and the liver and kidneys are next appealed to. By this time, however, the depraved state of the blood is telling on the nervous system, and the appetite, rumination, and digestion are impaired. The drain of fluid taking place also, no doubt, affects the functions of the third stomach, and accounts for the peculiar dryness of its contents. The action of the stomach and bowels being thus interrupted, the ability of the liver is necessarily limited, from relieving the loaded condition of the blood, and it suffers locally in attempting to effect that which it cannot accomplish. The kidneys are now the last outlet of the system to which appeal is made for relief, and upon them the full force of the disease impinges. It is thus that they become the victims of disease, in the production of which they are noways concerned, and after death often show signs of approaching disorganisation. The same may be said also of the heart. This organ being left to supply the wants, and carry on the work of the system, with a decreased and deteriorated fluid, endeavours to make up by increased frequency and strength of action, and hence its bounding force during life, and the appearances of over-excitement met with after death.

Causes of the disease.—Having now developed in some measure the nature of red water, we can with the greater certainty follow up the same train of inquiry, by discussing its causes and the rationale of its treatment.

The immediate cause of the disease is a disproportion between the saccharine and azotized constituents of the food. Turnips contain this disproportion. According to the most authentic analysis of this root, it contains about ten per cent of sugar, and one or one and a half per cent only of vegetable albumen: hence its value in the feeding of stock. Liebig, and such physiologists as follow him, have shown the principal use of sugar in the food to be, the supply of carbon and hydrogen, as elements of respiration, for the support of the animal heat. In ordinary circumstances, whatever is left over these offices is converted, they tell us, into

fat, and laid up in the cellular membrane as a sort of reserve fund, for the same purpose at some future time. In the case of an animal giving milk, however, the supply of sugar needful for that fluid has to be derived from the same source; and whether we suppose it to pass directly from the digested food through the blood to the udder as sugar, or to be first converted, as some suppose, into fat, and then reconverted into sugar, matters but little to our argument. The first idea seems by far the most likely, and is greatly confirmed by the immediate and obvious effect which an additional quantity of sugar in the food produces on the secretion of milk. As I have already noticed, however, the cow cannot make milk out of sugar alone; and the other elements of the secretion not being duly afforded, the tendency is to draw upon the blood, and through that fluid upon the body at large, for what is deficient. Still this will not produce red water unless certain other predisposing conditions be also present. Of these the chief are, 1st., constitutional peculiarity inherent to animals of slow-growing breeds; and 2d, the excitement of the lactiferous organs consequent upon parturition. In animals, upon the breeding of which little care has been bestowed, such as the old native kinds still common in many parts of Scotland, the vascular system is but moderately developed, and the assimilative powers comparatively weak; and hence, any vicissitude of nutrition, whether in the form of loss or accession, is more severely felt by the constitution than it is in those of more rapid-growing qualities. The constitutions of well-bred stock, from their more artificial habits and nurture, or possibly in part from a repeated selection of certain qualities, seem to be possessed of greater pliancy under changes of keep, and hence escape with comparative impunity certain diseases (of which red water is one) that have their origin in deranged nutrition. It is this want of assimilative power that *allows*, while the naturally excited state of the udder after calving *causes*, the vital constituents of the blood to be *overdrawn* upon by the undue proportion of saccharine matter in the food, and thus produces the excessive flow of milk which we find invariably to precede red water. Were the assimilative forces greater or more pliant, either the extra amount of carbon and hydrogen in the sugar of the food would be converted into fat, and deposited in the cellular membrane, or the other tissues of the body would undergo a waste equivalent to the draught upon the azotized and saline constituents of the blood, and that fluid retain its normal condition.

Each of these causes that I have named is shown to be operative in the production of red water, by an appropriate fact, prominently connected with the disease. Cause 1st,—That a disproportion of sugar produces it, is shown by the disease only occurring when the animal is liberally fed on turnips; and not only this, but stinted in certain other kinds of food. In town dairies, where

bruised grains, draff and dreg—aliments which contain a much greater proportion than turnips of matter capable of yielding the saline and caseous constituents of milk—are used in feeding the cows, red water never happens, however abundant the flow of milk may be; so that it is not the actual quantity of milk yielded that is hurtful, but its being greater than the food given is capable of supplying *all* the constituents for. It is the want of proportion in the elements of nutrition supplied that disturbs the equipoise of the animal machine. Cause 2d is proved by the rarity of the disease in short-horn and other well-bred and fast-growing and feeding varieties of stock; and Cause 3d by the disease never occurring in the form under notice, except within a short time after calving.

Another corroborative proof of the part which the sugar of the turnip has in producing red water, is that, other things being equal, those seasons in which turnips have been most abundant and of best quality, have been most productive of the disease. And, again, that it is most common in autumn and spring, less so in winter: the explanation of which is, that during the dead season of the year, when the growing powers of the plant are dormant, a proportion of its non-azotized matter exists in the condition of starch and gum, which, on the approach of spring, is first converted into sugar previous to its becoming green leaf and woody fibre. The effect which the sprouting of turnips in spring has upon the production of red water has been noticed by almost every one who has paid attention to the subject,* and has been by some attributed to their indigestibility, and by others to their purging action; of the former of these properties, however, we have no proof whatever, while the latter is merely a consequence of their non-azotized matter being in its saccharine or most soluble form. To explain this, it needs to be mentioned, that the composition of vegetable gum, starch, sugar, cellular fibre, and woody fibre, are all identical, except in the proportions of water they contain; and that the order in which I have put them is that through which they pass in forming the nutritive matter of the turnip bulb into a woody top, covered with green leaves, flowers, and ultimately seed. It is not, however, till the plant approaches the degree of maturity requisite to the perfecting of its seed, that the woody fibre begins to predominate so as to be in the least likely to make it indigestible. The solubility of the saccharine condition of the non-azotized matter of the plant seems necessary to the intermediate part that sugar plays in the conversion of gum and starch into cellular and woody fibre; and hence we are justified in inferring, (setting other more direct proof aside,) that the time the turnip is in the most

* Red water will also be produced in spring by turnips which had been stored in the early part of winter, and which have not yet sprouted.—EDITOR.

luxuriant stage of its growth in spring—that is, when full of green leaf, and before the appearance of the flower—is the time when, as a whole, it contains the largest proportion of sugar. No doubt, at this time the bulb is becoming spongy and sapless; but the deficiency is more than compensated for by the quantity in the stems and leaves; and hence, as I have above noticed, their purgative effects.

The treatment (*preventive.*)—The prevention of red water is in a great measure indicated by the nature of its causes, and consists in obviating them. The first and most important measure is the selection and propagation of well-bred, fast growing, kindly feeding animals as cows. Where this is attended to, the experience of every part of the country to which I have been able to extend either my observations or inquiries, shows it to be effectual.* As this change, rapidly as it is progressing, and desirable and profitable as in many respects it is, must yet be a work of considerable time; and as the less improved and inferior sort of animals will, as a rule, be always found in the possession of the poorer portion of the occupiers of the land, it is of some importance to point out what other preventive measures science may indicate.

Of course, the parturition of the animal (one of the causes) cannot be avoided; but such precautions may be adopted as to cause the period of danger to pass over safely. The quantity of turnips both before and after calving should for some time be limited; and instead, the cow should be allowed, at least after calving, small quantities of oilcake, bruised grain, or linseed, or some other artificial aliment, in which the proportion of the albuminous to the saccharine matter is greater than in turnips.† This would not only, from the limited quantity of sugar in the food, lessen to some extent the amount of milk given, but it would also increase the other constituents of the blood, from which it has to be produced; and hence both causes acting, would materially tend to keep the balance of the constituents of the blood normal, and to prevent the disease.

Bleeding previous to calving has been recommended; but it is difficult to see how it can act beneficially, unless by tending to limit the flow of milk afterwards; and this is but doubtful. Purgative medicines, after calving, might be more rationally expected

* We have had both short-horn and Angus cows affected with red water when under the same treatment.—EDITOR.

† We have found a small quantity of oilcake—say 1 lb. a-day—given to each cow for a fortnight previous to calving, and as long after as they received turnips, prove an effectual *preventive* to red water. In a communication from Sir John Stuart Forbes, Bart. of Fettercairn, of as recent a date as the 19th May 1851, a correspondent of his informs him that linseed, given to his cows previous to and after calving, has entirely prevented the recurrence of red water in cows. Corroboration of the good effects of oilcake in preventing red water in cows is also given in Stephens' *Book of the Farm*, vol. i., paragraph 2242, of the new edition.—EDITOR.

to answer this end, and should at least be attended to, so as to regulate the condition of the bowels. Theory might suggest other means of limiting or reducing the flow of milk, instead of increasing the materials from which it has to be produced; but granting that such could be used without detriment to the health of the animal, which is far from being certain, they are not practically sure in their effects, nor would they be profitable if they were.

Treatment (remedial.)—The disease of red water once established, the indications of cure become perhaps equally complicated with any ailment which the veterinarian has to treat; and without the insight which chemistry affords into its nature and causes, the blundering and hap-hazard treatment which has so often been prescribed for it, is not to be wondered at. As it would serve no good end, I need not here review the various plans which different authors, each in accordance with his own assumed view of the malady, has proposed; but proceed at once to consider how the different disordered functions, which we have seen to exist in the animal machine, may be put to rights. Could the disease be caught at the critical time, when nature is trying to throw it off by the bowels in the form of a black fetid diarrhœa, the effects of a dose of physic of any kind, so as to keep up the existing determination, would be of the greatest benefit; and even at whatever stage of the disease we may be called, purging is of the first importance. It is often of consequence, however, to weigh well the form of purgative to be used. As debility and sinking are prominent features of the disease, the nauseating effects of strong saline purgatives are rather to be avoided than otherwise; and the same may be said of calomel, tartar emetic, and the whole class of what are commonly termed fever medicines. On the other hand, when we bring to mind the material deficiency of saline matter in the urine, and take that, as we are justified in doing, as a measure of its paucity in the blood, the exhibition of a portion at least of mineral medicine is called for. Beyond alterative doses, however, it is not generally advisable; and nothing but the risk of death, arising from obstinate obstruction of the bowels, should justify the application of strong doses of saline medicine.

Blood-letting has, by a few, been advocated as one of the means of cure; but most writers have doubted its propriety; and I think a glance at the pale and blanched appearance of the mucous membranes during life, and the actual deficiency of blood in the body after death, is enough to put a termination to the practice. It is not enough to say that such an animal was bled and got better: it may have got better in spite of the bleeding; but is that a reason for its use while contra-indicated by every feature of the disease? The question is, would not the recovery have been much easier and equally sure without the bleeding? The only symptom seeming to indicate bleeding is

the bounding and quickened action of the heart. While this was supposed to be a sign of fever or inflammatory action, the mistake was pardonable; but with the proof that we have before us that it is rather the palpitation of nervous debility, the case stands reversed, and, instead of depletion, stimulants are pointed out.

The exhibition of stimulants, from the very commencement of the treatment of red water, may to some appear heroic practice; but having given them every latitude of trial, I have never failed to observe benefit to the patient from their use. In fact, I have never lost a case to which the stimulant plan was early and fully applied, unless from the existence of some accidental complication, against which they could be of no avail. Of course, I speak of stimulants combined with purgatives and other appropriate means. In the exhibition of them I have often observed the most visible effects upon the action of the heart, pulse, and other symptoms of sinking. Giving a dose of some of the stimulating tinctures, combined with gruel and strong ale or porter, I have seen the patient a few hours after, and found the action of the heart, from being heard at some yards' distance, reduced to quiescence—slower in its movements—the pulse full and soft where it was previously inappreciable, and the ears and extremities warm where they were formerly cold and chilly.

Along with stimulants, I have found the greatest benefit in the use of the preparations of iron, especially during convalescence. The formation of new and healthy blood is a necessary part of the cure; and we know that without iron this cannot be accomplished. Nor is its use in red water anything new. Forty years ago, a successful method of treating it was the boiling of rusty iron in water, and the giving of the solution thus formed to the patient; and it has been observed, on various farms where the water is strongly impregnated with iron, that red water hardly ever made its appearance, or, if it did, that it seldom required treatment.

As stimulants and tonics, gentian, ginger, and cardamom, may be usefully applied. The latter, in the form of tincture, was for many years held as an infallible remedy in a district of country with which I was for some time connected, and in which red water extensively prevailed, and was a source of no small credit, and profit also, to one or two who knew the secret, and kept it as such. In giving both iron and the vegetable stimulants, I much prefer the form of tincture to the dry condition of the medicines in powders. They seem to find a much readier access into the system, and to produce their effects much quicker in the alcoholic solution than in any other way. The only objection is their cost.

There are other two classes of medicines which, from the frequency with which they have been used in the treatment of red water, demand a passing notice; although I have never used either of them to an extent to enable me to speak with confidence

of their effects experimentally, nor have, from the little of them I have tried, derived any marked benefit. They are diuretics and astringents; the one given with the view of clearing the water, by causing it to throw off its impurities largely and freely; the other in the intention of stopping at once their flow. Were we sure that it was advantageous to remove with rapidity the impure and effete matter of the blood, and had we not before our eyes the fear of a too speedy and complete diminution of the vital fluid, bad as it is, and also the risk of setting up local irritation in the kidneys to a greater extent than previously existed, diuretics might be safely applied. On the other hand, astringents are liable to similar exceptions. Even if sure that they would reach and affect the kidneys, which is doubtful, we are in still greater uncertainty if doing well or not, in checking the discharge from the blood of matter which we are certain is, in its present existent condition, past the term of being useful. And, however this may be, we are sure of a hurtful effect on the bowels, and, through them, on our patient generally, from the use of such astringents as tend to check the action there.

With these uncertainties attending their action, I have found it to be my duty to my employers to avoid, with few exceptions, the use of both diuretics and astringents in treating this disease, and instead, to trust mainly for a cure to restoring the action of the bowels and stomach when suspended, as is commonly the case, and sustaining the sinking powers of the system. For this purpose, I have found linseed gruel a powerful adjuvant, with plenty of treacle and strong ale or porter; and when oily purgatives were given, the addition always of a few eggs.

Instead of giving a dogmatic system of treatment, as is the common plan in most veterinary essays, I shall here relate a few cases, with the means used, and the results that followed:—

Case 1st—6th Nov. 1847.—The same as already spoken of in detailing the symptoms. About a quart of blood was taken away when the patient was first seen, which produced such a degree of faintness as put a stop to continuing the operation. A strong saline purgative was given, consisting of Epsom salts, common salt, calomel, croton seeds, and ginger. A few drachm doses of tartar-emetic were also ordered to be dissolved in the patient's drink as she would take it. Next day, the cow being worse, and the bowels not having responded in the slightest degree, the purgative was repeated, accompanied with glysters; the tartar-emetic omitted, and ale given instead. The patient died the following night. The post-mortem appearances I have already detailed. It was the first dissection of a red-water case I had made, and I confess that it was not without certain qualms of conscience that I observed the manifest evidences of anemia which the appearances after death presented, and reflected on the bleeding and

nauseating treatment to which during life she had been subjected. To my own mind the conclusion that the treatment had aided in producing death was irresistible.

Case 2d—9th Nov. 1847.—Of this I have also given the symptoms, by reference to which the similarity between it and the preceding one will be seen. The treatment first adopted was the exhibition of an oily purgative, ol. lini, f. ℥ xxiv., et ol. crotonis, gt. xxv. M., and made into an emulsion with two or three eggs. On the second day plenty of linseed gruel was given, and the following mixture ordered to be given daily:—

R/ Tinct. Mur. Ferri, . . . ℥ i.
— Cardamomii, . . . ℥ iii. M.
Sig. to be given in strong ale or porter.

Third day, urine natural, and bowels beginning to act; continued the mixture and linseed gruel. Fifth day, cow eating as usual, and apparently well.

Case 3d—22d April 1848.—Animal seen in the forenoon; very weak; pulse from 80 to 90 per minute; heart beating strongly; milk, which had previously been abundant, nearly gone; neither eating nor ruminating; extremities cold; ears warm; nose moist; urine dark red; bowels obstructed. Ordered immediately

R/ Ol. Lini, . . . f. ℥ xx.
Ol. Crotonis, . . . gt. xxx. d.
Sig. to be mixed with two or three eggs.

In the evening ordered,

R/ Tinct. Cardamomii, . ℥ ii ss.
— Mur. Ferri, . ℥ i ss. M. Sig. to be given in ale.

Ordered also for the morning and evening of the succeeding day, the following powders:—

R/ Sulph. Ferri,
Pul. Gentianæ, ā ā, . ʒii.
— Sem. Crot. Tig, . gr. xxv. M. et ft. Pulv.
Sint ii tales. Sig. to be given in gruel.

Second day, action of heart much moderated, and temperature of body rather better; but urine still red, and bowels unacted upon. Repeated the oily purgative, and ordered linseed gruel and strong ale.

Third day, much better; urine only slightly brown; bowels acting moderately; temperature nearly natural; animal eating a little, but still weak; heart acting rather strongly. Ordered

R/ Tinct. Gentianæ.
— Cardamomii.
— Mur. Ferri, ā ā, . f. ℥ ii. M.
Sig. one half to be given immediately, and the other the following day; and the linseed gruel and ale to be continued till the appetite and strength are restored.

Case 4th—1st May 1848.—The symptoms in this case were those ordinarily met with in red water, but of a mild form. The treatment was begun by giving

R/ Ol. Lini, . . . f. ℥ xxv.
— Crotonis, . . . gts. xx.
Tinct. Cardamomii.
— Gentianæ, ā ā, . . ℥ i.
— Mur. Ferri, . . ℥ ss. M. et ft. Haustus.
Sig. to be mixed with two or three eggs.

Second day, bowels acting; water still red. Repeated the tinctures as above, with ol. crotonis, gt. x. st., added for a day or two in plenty of linseed gruel.

Case 5th—7th April 1849.—Much debility; pulse about 100 per minute, and heart acting with much force; bowels constipated for previous twenty-four hours; appetite and rumination suspended; extremities cold; giving a little milk; urine deeply claret-coloured; general appearance of animal unfavourable, being thin in condition, and hardly able to rise. About ten days calved, and had been giving abundance of milk. Gave, on first seeing her—

R/ Ol. Lini, ... ℥ xxv.
— Crotonis, . . . gt. xxx.
Tinct. Cardamomii, . .
— Gentianæ, ā ā, . . f. ℥ i.
— Mur. Ferri, . . f. ℥. ss. M. et ft. Haustus.
Given as usual in a few eggs.

Second day, (morning,) no amendment; animal very weak; no motion in bowels; rectum on examination empty and dry; repeated the physic of yesterday, and ordered two powders, one to be given at mid-day, the other at the same hour on the following day, in gruel. The powders were—

R/ Sodæ Bi Carb.
Magnes. Carb.
Ferri Carb. Sacch. ā ā ℥ ss.
Pul. Sem. Crotonis, ʒ ii.
— Capsici, ʒ ii. M. et ft. Pul.

Same day, (evening,) bowels still unacted on; state of the rectum the same; animal rather livelier; eating a few leaves of kail when put into her mouth; still giving a little milk; urine red as at first; temperature low; very weak; unable to rise without help. Gave, in gruel—

R/ Sulph. Magnes. . . lb. i.
Sodii Chloridi, . . ℥ iv.
Hyd. Sub. Mur., . . ʒ ii.
Pul. Sem. Crotonis, . ʒ i.
— Jalapæ et Zingiberis, ā ā ℥ i. M. et ft. Pulv.

Third day, no amendment; urine still red; bowels unacted on; afraid to give more physic; gave the second of the two powders ordered above, in plenty of gruel with treacle and strong ale; and ordered glysters to be given frequently till the physic acted.

Fourth day; urine beginning to clear; general appearance rather better; bowels beginning to act. Gave—

℞/ Tinct. Cardamomii, . f. ℥ iii.
— Mur. Ferri, . f. ℥ i. M.
Sig. to be given at twice in strong ale.

Fifth day; cow purging briskly, otherwise improving; repeated the mixture as on previous day. Sixth day; still purging; urine natural; temperature improving, except in hind feet; cow eating a little, and rather stronger, being able to rise without help; giving still a little milk. From this date she slowly recovered from the constitutional effects of the disease; but one of the hind feet never regained its circulation; and about a month afterwards the skin began to separate around the upper pastern joint, and in a short time the foot dropped off by the end of the shank bone.

A much extended list of cases might be cited, but the above are sufficient to show the general principles by which our treatment of red water should be guided. They consist in restoring the functions of the digestive system—stimulating the sinking nervous powers—supplying such elements of nutrition and waste as will tend to renovate and renew the blood—and guarding, as far as in our power, against the local sequelæ of the disease. Of the latter we have various forms. Internally the liver, the kidneys, the third stomach, and the heart, are each more or less liable to suffer, and while our means of ascertaining the exact condition of either of them are limited, our power of remedying is also small. A certain stage of structural derangement once established in either of these organs, death is inevitable. Hence the propriety of prompt and efficient constitutional means being at once resorted to. It is true that a number of the milder cases of red water would get better themselves through the unaided efforts of nature. It is also true that many such are aggravated and made dangerous by the injudicious treatment applied to them. Still, this does not in the least argue the neglect of such means as tend to lessen the danger of the ailment, or reduce to a minimum its hurtful after-consequences. Of these, the most common are, the failure in the secretion of milk, deterioration of condition, and the probable loss of the tail or hoofs. The latter loss often occurs when the debility of the disease runs beyond a certain limit, and is simply a consequence of want of circulation in the extremities too long allowed to continue. When we have reason to suspect, from the coldness and insensibility of the parts, that this is about to take place, our only chance of avoiding the evil is the application of artificial or external warmth, by means of bandages, or irritating or stimulating substances; and so long as a dread of such loss continues, the means of preventing it should be persevered in.

In the preceding remarks, I have abstained from allusion to any of the other forms of red water but the puerperal. In the few cases of the disease that I have met with in young animals, I have found it to be an entirely different form of ailment. To

the practised eye the general symptoms of the diseases are widely different; but beyond this, the character of the urine affords us a conclusive discriminating test. In two examinations of red urine from young cattle that I have had an opportunity of making, it was in each hæmaturia. Under the microscope, the urine presented distinct blood globules: it gave a dark-coloured sediment after standing at rest for a few days; and on the application of heat, gave a jelly-like coagulum, not having the slightest resemblance to the floculent precipitate of puerperal red water. With these differences in the composition of the urine, it would, I think, be an outrage on pathology to force this disease into the same category as the one I have been treating of. It demands a separate process of examination for itself.

In conclusion, while believing that I have developed the true nature of puerperal red water, I am also conscious that a number of the circumstances connected with it are but imperfectly explained; and that, to render the investigation complete, there are still several points to which chemistry might be profitably applied. For instance, an analysis of the milk, both before the occurrence and during the progress of the disease, and also of the blood, would tend, I have no doubt, to confirm the views I have expressed, and might also lead to others not yet surmised of. Interesting trials might also be made, of the effects of more concentrated saccharine aliments upon newly-calved animals of different breeds. Enough has been, in the mean time, brought out, to give the cue to those willing to follow up the same mode of investigation; and at all times "let every one write that which he knows, all that he knows, and *only* what he knows."

PROCEEDINGS IN THE LABORATORY.

By Thomas Anderson, M.D., Chemist to the Highland and Agricultural Society.

ON THE COMPOSITION & VALUE OF COMMERCIAL SUPERPHOSPHATE OF LIME.

When the attention of farmers was first directed to the use of dissolved bones, or superphosphate of lime, various receipts, all similar in principle, though differing in minor details, were given, by means of which the farmer might prepare a sufficient quantity of this manure for his own use. During the last few years, however, large manufactories have been established, and sundry patents have been taken for the solution of bones; and the consequence has been, that the preparation of dissolved bones on the farm has become almost extinct, and the farmers, with few exceptions, trust to that which they can purchase from the manufacturer. By doing so, they of course escape all the trouble and annoyance inseparably connected with such a process on the small scale, and expect to have the advantage of the economy which must neces-

sarily be effected on large manufacturing operations. During the last few months my attention has been devoted to some extent to this question; and a number of analyses of different dissolved bones, or superphosphates commonly met with in commerce, have been made, which have led me to the conclusion that the private manufacture of dissolved bones is much preferable, and much more economical, than the purchase of the ready-prepared article; and the grounds of this conclusion I propose to point out in the following observations. Simple ground bones, as supplied to the agriculturist, consist principally of organic matter and phosphates, with small quantities of other salts. They vary, of course, to some extent in composition; but the following analysis of a sample recently made in the laboratory, may serve as a fair illustration of samples of good quality:—

	Water,	6.20
	Organic matter,	39.13
	Phosphates,	48.95
(1.)	Lime,	2.57
	Magnesia,	0.30
	Sulphuric acid,	3.15
	Sand,	0.30
		100.60
	Quantity of ammonia which the organic matter is capable of yielding,	4.82

The sample was from the manufactory of Messrs Turnbull and Company of Glasgow, and I believe consists almost exclusively of the bones of the horse.

Agricultural bones may be said, in round numbers, to contain 50 per cent of phosphates, and 40 of organic matter. But bones are also extensively met with in commerce, from which a large proportion of the organic matter has been extracted by long-continued boiling, and which contain, of course, a proportionately larger amount of phosphates—the quantity ranging, in some instances, as high as 70 per cent, or even more. Now, the phosphates consist almost entirely of phosphate of lime, a substance entirely insoluble in water, and from which the phosphoric acid is less readily and rapidly taken up into the plant than it would be from a soluble phosphate. There exists, however, another compound of phosphoric acid and lime, known to chemists by the name of biphosphate of lime, which is readily soluble in water, and contains, in combination with phosphoric acid, only half the quantity of lime which is present in the ordinary phosphate contained in bones. It will be readily understood, then, that in order to convert the phosphates of bones into a soluble condition, all that we have to do is to remove from it one-half of the lime which it contains. This is effected very readily by the addition of sulphuric acid, which combines with a certain proportion of the lime, and forms with it sulphate of lime or gypsum, and leaves the biphosphate of lime, which is soluble in water. The phosphate of lime,

in fact, is dissolved by virtue of the sulphuric acid which is added to it; and so long as any acid exists, as we say, in the free or uncombined state, in the mixture, a certain proportion of phosphates will be soluble. In dissolved bones, then, there ought always to be a larger quantity of acids (phosphoric and sulphuric) than, taken together, are capable of uniting with the lime and other earths present in the bones. This, however, is far from being the case in many of the dissolved bones supplied in commerce, as may be seen from the following careful and complete analysis of such a substance:—

	Water,	8.341
	Organic matter,	22.429
	Lime,	24.577
	Magnesia,	1.951
	Potash,	1.414
(2.)	Soda,	1.337
	Sulphuric acid,	11.874
	Phosphoric acid,	13.162
	Chlorine,	0.239
	Carbonic acid,	4.942
	Sand,	10.053
		100.319

In this analysis, it will be observed, the exact quantities of all the individual constituents have been determined, and are set down exactly as they are obtained in analysis. A chemist will at once see that no part of the phosphates in this substance can be soluble; but it may be rendered still clearer by arranging the constituents in the forms of combination in which they actually exist in the substance, when we find the numbers to stand thus:—

Water,*	7.777
Organic matter,	22.429
Phosphate of lime, (bone earth,)	28.012
Chloride of sodium,	0.395
Sulphate of soda,	2.574
Sulphate of potash,	2.617
Sulphate of lime,	15.797
Carbonate of lime,	6.588
Carbonate of magnesia,	4.024
Sand,	10.053
	100.266

So far from any free acid existing in this substance, then, there is actually present no less than 6.5 per cent of carbonate of lime or chalk, and 4 per cent of carbonate of magnesia, both substances, the presence of which is entirely incompatible with the existence of phosphates in a soluble condition. It is easy to see how this manure has been manufactured, and also the reason why the

* I may explain, for the satisfaction of the chemical reader, that the phosphate of lime is calculated according to the formula, $8\ CaO\ 3\ PO_5 \times Ho$, and that the quantity of water required for the formula has been subtracted from that found by analysis.

method has been adopted. In fact, when bones are dissolved in the ordinary way, the free acid which they contain makes them extremely troublesome to carry, and causes them to corrode and destroy the sacks in which they are packed; and in order to dry them up, and prevent this corrosive action, it is customary to mix with the materials some dry substance, to absorb, as far as possible, the excess of acid. In this case, however, the manufacturer has obviously employed either chalk or lime, or perhaps old mortar—the effect of which is to neutralise the acid, and bring back the phosphates into the insoluble state; in other words, exactly to undo what the previous process of solution had done. I shall contrast the composition of this substance with that of the following, which is a specimen of *dissolved bones*, in the strict sense of the word, to which nothing has been added, and which contains a large quantity of free acid:—

(3.)	Water,	39.19
	Organic matter,	11.13
	Phosphates,	33.53
	Sulphuric acid,	12.81
	Sand,	2.69
	Alkaline salts,	0.65
		100.00

In this analysis we see that a large quantity of acid is in the free state, and, consequently, the greater proportion of the phosphates are soluble in water. At the same time, a very large quantity of water is present; much more, in fact, than we ought to have in a manure of this kind, and sold at so high a price as dissolved bones.

These two analyses, then, may be considered as illustrating the composition of two different sorts of so-called superphosphate which are met with in commerce; but, in addition to these, I have examined a great variety of other samples, the results of which are extremely varied, and serve to show how very different the substances are which are presented to the agriculturist under the same name.

The following is an analysis of what may be considered a fair sample of a very large proportion of the superphosphates met with in commerce, and in which, as in the first, some substance has been employed to saturate the excess of sulphuric acid:—

(4.)	Water,	16.141
	Organic matter,	20.949
	Phosphate of lime,	30.209
	Lime,	10.972
	Sulphuric acid,	13.233
	Sand,	8.402
		99.906
	Amount of ammonia which the organic matter is capable of yielding,	1.29

In this superphosphate there existed only a very small proportion of soluble phosphate.

Here is another, in which a small excess of sulphuric acid exists, but to which lime has been more sparingly added, so as not entirely to saturate the acid :—

(5.)	Water,	13.22
	Organic matter,	13.58
	Phosphates,	36.30
	Sulphate of lime,	25.86
	Free sulphuric acid,	2.14
	Alkaline salts,	1.50
	Sand,	7.40
		100.00

The organic matter in this case yielded only traces of ammonia.

The following three analyses belong to a different class of superphosphates, and contain very small quantities of organic matter, which yields only traces of ammonia :—

	(6.)	(7.)	(8.)
Water,	11.15	15.13	15.76
Organic matter,	3.57	4.85	5.46
Phosphates,	34.92	22.85	27.91
Sulphate of lime,	29.46	42.63	38.01
Sulphate of magnesia,	1.11	0.93	1.67
Free sulphuric acid,	1.13	7.16	2.73
Alkaline salts,	9.19	2.84	3.22
Sand,	9.47	3.61	5 24
	100.00	100.00	100.00

In all these last analyses, the nitrogenous constituents naturally present in the bones, and to which we must look as the source of ammonia in the manure, are almost entirely absent, either from bones having been employed which had been previously deprived of these substances by boiling, or owing to the use of coprolite, or some other mineral phosphate, as a substitute for bones. In the superphosphate, of which the following is an analysis, the attempt has been made to supply this by the addition of a salt of ammonia :—

(9)	Water,	12.03
	Organic matter and ammoniacal salts,	33.41
	Phosphate of lime,	23.89
	Lime,	10.56
	Sulphuric acid,	13 07
	Alkalis,	2.06
	Sand,	4 98
		100.00
	Ammonia,	4.13

Lastly, we have the analysis of a substance which, though sold under the name of bone manure, is a mixture of various substances, and contains, among others, a considerable proportion of common salt, (chloride of sodium,) and a little nitrate of potass.

(10.)	Water,	12.74
	Organic matter,	13.05
	Phosphates,	12.01
	Sulphate of lime,	29.45
	Sulphate of magnesia,	9.53
	Chloride of sodium,	11.06
	Sulphate of soda,	4.97
	Nitrate of potash,	2.80
	Free sulphuric acid,	0.50
	Sand,	3.89
		100.00

In all these analyses the phosphates are the bone-earth exactly as it exists in the bones, and in the insoluble condition; and the amount of it capable of dissolving must be estimated by the proportion of sulphuric acid specified in the analysis as existing in the free state. Where none is found in that condition, no soluble phosphates exist; and when only a trifling quantity, as in the last analysis, is free, a proportionally small quantity of phosphates will dissolve in water.

In comparing the values of different samples of superphosphate, there can be little doubt that the highest place must be given to those which contain the largest amount of soluble phosphates. It must, however, be admitted that we have no very distinct evidence of the amount of its superiority; and it is quite an open question whether a given quantity of phosphates, when dissolved, and again brought back by the saturation of the acid into the insoluble state, may not produce an effect as great, or nearly as great, as when actually in the state of solution. It is certain, at least, that the soil contains enough of those substances capable of uniting with the excess of acid to bring the phosphates back into the insoluble state, in no long time after their admixture with it; and when this happens, the advantages derived from the use of sulphuric acid, which I hold to be indubitably established by practice, must be attributed not to the solution directly, but indirectly, as affording the means of obtaining a higher state of division of the phosphates than can be produced by merely mechanical means. Whatever answer, however, may be given to this question—and I have already stated that we have not the experimental evidence required for a definite conclusion—one thing is certain, that the prudent farmer will take care to purchase those samples of superphosphate which actually do contain soluble phosphates, and take the chance of their being again brought back to the insoluble state by the lime of the soil, rather than those samples in which this change has been deliberately effected by the manufacturer.

My object, however, in bringing these analyses under the notice of the agriculturist, is not so much to compare the values of the different samples, as to show that a much superior manure can be made at a less price on the farm, than it can be purchased. Dissolved bones are sold at different prices, but those most com-

monly met with are charged from £7 to £8 per ton. Now, the farmer can buy rough bones at about £3 to £3, 10s. per ton; inch bones at about £4, 12s.; and bone dust at £5. Suppose, then, that he proposes to convert one ton of bones into superphosphate, he will employ for the purpose about one-fourth of their weight of oil of vitriol, which I shall assume to cost £8 per ton, although it is frequently as low as £7. Then the expenses will stand thus—

1 ton inch bones,	£4	10	0
¼ ton sulphuric acid,	2	0	0
Labour, &c., say	0	10	0
Cost to the farmer of 1¼ ton of dissolved bones,	£7	0	0

Practically, of course, the weight of the article as made will be more than 1¼ ton, because a certain quantity of water must be added to the sulphuric acid, of which, however, I do not take account here. I have likewise assumed the use of inch bones, but it is quite possible to make superphosphate with the crude bones, of course at a proportionately less cost.

It is obvious, then, that, by the home manufacture of dissolved bones, we can produce 1¼ ton for the price at which *one* ton can be purchased from the manufacturer. But this is not all; for it is manifest that the 1¼ ton produced will be much more valuable; that is to say, contain a much larger quantity of valuable ingredients, than an equal weight of even the best sample of which I have given the analysis. Supposing bones of the ordinary average composition to be employed for solution, we find the following as the quantity of phosphates and of ammonia, in the assumption that bones are capable of yielding, on the average, 4 per cent of ammonia:—

Quantity of valuable constituents contained in 1¼ ton of dissolved bones, produced at a cost of £7; viz.—

Phosphates,	1120 lb.
Ammonia,	89 lb.

I shall contrast this with the analysis marked No. 3; but as the amount of ammonia was not determined, I shall suppose the organic matter to yield $\frac{1}{10}$ of its weight of that substance, which is about the quantity yielded by the organic matter in the analysis of ground bones.

Quantity of valuable constituents in 1¼ ton of superphosphate, purchased at a cost of £8, 15s; viz.—

Phosphates,	938 lb.
Ammonia,	28 lb.

The home-made manure therefore contains 180 lb. of phosphates, and 51 lb. of ammonia, more than the manufactured article. The value of these, reckoned at the same cost as the phosphates and ammonia in a guano, would amount to about £1, 15s.; so that the farmer buying 1¼ ton of superphos-

phates of the particular sort now analysed, actually pays about £3 more than he can obtain the same quantity of valuable ingredients for when he manufactures his own superphosphate. The difference in value will be found even greater in some of the other samples, all of which might be easily calculated on the same principle; but I shall content myself with one example, and shall select No. 5, which is by no means the worst examined.

Quantity of valuable constituents in $1\frac{1}{4}$ ton of superphosphate, No. 5, costing £8, 15s.; viz.—

Phosphates, ...	1116
Ammonia, ...	none.

It will not, I think, be doubted, that a very decided economy may be effected in the home manufacture of dissolved bones; indeed, my estimates probably fix the saving at a less amount than it would actually be found to be in practice. I have assumed the cost of labour at 10s. per ton of bones, which would probably be far above the actual cost, and have taken a price for the purchased superphosphate decidedly under the average of that at which they are usually sold.

It will be unnecessary for me to enter at any length into the method to be employed for the solution of bones, which is sufficiently well known. I may observe, however, that the older receipts recommended the use of a quantity of sulphuric acid equal to about half the weight of the bones, a proportion which is never employed by manufacturers of superphosphate. I have in my estimate of the cost taken one-fourth as the proportion to be employed, and this under ordinary circumstances will yield an excellent superphosphate. The quantity may be raised to 6 or 7 cwt. of acid per ton of bones, with the effect of producing more thorough solution; but I doubt much whether the advantage gained is at all commensurate with the increase of cost.

In dissolving bones on the large scale, various methods are now employed. Some manufacturers use artificial heat to promote the solution, others employ a revolving cylinder into which the bones and acid are introduced, and mixed in a more complete and uniform manner than they otherwise could be. These contrivances, no doubt, have their advantages on the large scale, and must effect a considerable economy of labour, but they are not at all necessary for the preparation of small quantities. The bones, acid, and water, may in fact be simply mixed together in any sort of vessel; but when the farmer employs a considerable quantity, I believe it will be found advantageous to have a vessel specially adapted for the purpose. The requisites are a cistern of lead, or even of wood strongly made and bolted together, and an ordinary watering-can, made of *lead*. The proportions to be employed are—

1 ton of inch bones.
$\frac{1}{4}$ ton of sulphuric acid.
$\frac{1}{4}$ of a ton, or 60 gallons, boiling water.

A small quantity of the bones should be spread upon the bottom of the cistern, and the sulphuric acid gradually poured on from the leaden watering-can at the same time that a proportionate quantity of the water is added from another watering-can. More bones should then be thrown in, then more acid and water; and, in short, the process should be managed so as to intermix the bones, water, and acid as uniformly as possible. The mixture should be allowed to stand for some days before it is employed, and it should then be mixed with some dry peat or soil, in order to render it sufficiently dry for use. The mixture thus made may be preserved for any length of time before being used, so that it may be made at any time which may suit the other operations of the farm; all that is necessary being that it shall be kept under cover.

FURTHER OBSERVATIONS ON GUANO.

In a previous number of the *Transactions* I published some observations on the adulterations of guano, accompanied by a table of the average composition of the different varieties of that manure, so far as they had then fallen under my observation. Among other varieties, I referred particularly to Bolivian guano, and gave the results of two analyses, which induced me to place it on a level, as to value, with the finest Peruvian. Since that time I have had occasion to examine several additional samples of Bolivian guano, which have served to show that the analyses already published cannot in anywise be considered as representing the average composition of the Bolivian guano imported, but that these samples are rather exceptions, and that the bulk of the guano to be met with in commerce under that name consists of two different varieties, equally distinct from those of which I have before given the analyses, and from one another. Neither of these latter sorts are to be compared with Peruvian guano in value, and one of them must be considered an extremely inferior variety.

The following analyses give the composition of the better sort, which, it will be observed, does not greatly differ from Saldanha Bay in its composition:—

	(1.)	(2.)
Water, ...	15.91	19.32
Organic matter and ammoniacal salts, .	12.65	15.18
Phosphates, ...	54.67	52.24
Alkaline salts, ...	14.02	10.45
Sand, ...	2.75	2.81
	100.00	100.00
Ammonia, ...	2.71	2.79

The other variety, in its external characters, appears superior to this. It is drier and paler coloured, and has a very uniform appearance. It is immediately distinguished by its effervescing very strongly on the addition of an acid. Its analyses gave the following results:—

	(1.)	(2.)	(3.)	(4.)
Water,	15.07	16.24	16.66	16.71
Organic matter and ammoniacal salts,	22.51	23.83	24.35	29.73
Phosphates,	27.45	21.88	21.07	20.29
Carbonate of lime,	20.65	18.17	12.45	15.78
Sulphate of lime,	—	9.82	18.57	6.20
Alkaline salts,	5.45	1.15	1.40	4.09
Sand,	8.87	8.91	5.50	7.20
	100.00	100.00	100.00	100.00
Ammonia,	4.78	3.32	3.45	5.52

At first I was inclined to consider these as adulterated guanos; but I have come to the conclusion, from evidence which it is unnecessary to detail, that they are exactly as they were imported. Their value is very small, less even than the former variety, which cannot be estimated very highly; and the farmer, in making purchases of Bolivian guano, will do well to be very careful in ascertaining which of these varieties he gets; for, should his sample be equal to those of which I gave the analysis in my former paper, he can afford to give for it the same price as for Peruvian, while I need scarcely say that, for either of the others, the price ought to be very much lower.

The discovery of guano in Western Australia has recently made some noise; and it may therefore be interesting to the agricultural public to see the analysis of a sample made in the laboratory, which, however, may not fairly represent the average composition of the variety. It had been preserved for some time in a paper-parcel, and is probably, therefore, drier than it would have been if the analysis had been made immediately after its being taken from the cargo:—

Water,	11.33
Organic matter and ammoniacal salts,	15.43
Phosphates,	58.43
Lime,	2.02
Sulphuric acid,	3.24
Alkaline salts,	5.44
Sand,	4.11
	100.00
Ammonia,	2.61

This guano is also most nearly comparable to Saldanha Bay, and, like that variety, is principally distinguished by the large proportion of phosphates which it contains.

ON THE COMPOSITION AND COMPARATIVE FEEDING VALUES OF TURNIPS GROWN UNDER DIFFERENT CIRCUMSTANCES AND IN DIFFERENT LOCALITIES.

During the last few years the feeding of stock has undergone a development which has made it a much more important question in the general agriculture of the country than it ever was before. Up to within a very few years, indeed, especially in Scotland, the production of fat stock was almost entirely confined to farms situated in the immediate neighbourhood of large markets, or admitting of easy access to them, and was looked upon as a matter which could only be profitably carried on under such circumstances. At the present time, however, partly owing to the increased facilities of carriage, and partly to the introduction of an improved cultivation, the feeding of stock, to a greater or less extent, has extended itself to districts which are comparatively remote, and is looked upon as almost inseparable from the system of high farming now practised in our best and most skilfully cultivated districts.

The development of this system is mainly attributable to the extension of turnip cultivation. It has, however, been long acknowledged that, in order to obtain the full benefit of this root, it must not be employed alone, but must be conjoined with some other less succulent food; and the knowledge of this fact has led to the introduction, in very large quantity, of food of foreign growth, which is imported on to the farm, partly to be re-exported in the form of flesh and fat, and partly to be left as manure for the production of future crops. These foods, however, are necessarily costly; and the large item which they form in the annual expenditure of a well-cultivated farm, has opened up the important question of the economy of food, and led to a considerable number of experiments, made with the view of obtaining a more correct estimate of the comparative value of different substances, than could be formed from the loose estimates which were made at a time when the agiculturist did not look so closely and carefully to his expenses as he is now compelled to do. The different volumes of the Transactions of the Highland and Agricultural Society contain reports of a considerable number of such experiments, many of them very carefully made, and from which very valuable conclusions may be drawn. Much, however, still remains to be done; indeed, the experiments are so laborious, and require so much more attention than it is generally possible for an ordinary farmer to devote to them, that they have been almost entirely confined to the substances most commonly employed, and have not been extended to many sorts of food, on the comparative values of which definite information would be most valuable to the practical farmer. It fortunately happens that the comparative feeding values of different substances is one of those questions peculiarly adapted to chemical inquiry; and I think I am justified in stating that some

of the most important and valuable contributions which that science has made to the progress of agriculture, have been the investigation of these substances. Some of these researches are very complete, but others are extremely limited, and many great gaps exist, numerous substances being still wholly unexamined, while of others the analyses are much too limited in number to admit of our drawing any inferences as to their general composition, and the extent to which they may vary from the average under different circumstances. The attention of the Chemical Committee of the Highland and Agricultural Society has been particularly directed to the importance of such inquiries; and I have, at their request, undertaken a very extensive series of analyses, with the view of presenting, as far as is possible in the present state of chemical knowledge, the average composition of all our different sorts of food, and of deducing from them a series of tables of the comparative feeding values of these substances. These analyses have now been in progress for some time; but it must be obvious to every one acquainted with the amount of time required for chemical analyses, that a very protracted time must necessarily elapse before so extended a plan as that I have laid down to myself can be completed in all its integrity.

The series of analyses which I now lay before the public, contains the determination of the constitution and comparative values of turnips, grown with different manures and under different circumstances, and will serve to show the extent of the experiments required in certain branches of the proposed investigation. My attention was directed, in the first place, to the turnip, partly because it must be considered the foundation of all systems of feeding, and partly because some statements of a somewhat remarkable character were brought under our notice regarding the alleged superiority of turnips under certain circumstances. It was particularly stated that turnips grown with farm-yard manure fed better than those which had been manured with guano, and that a decided difference was also observable between samples grown at different heights. These statements were made by persons whose opinion was worthy of attention, but they were by no means universally concurred in—many farmers, whose opinion was entitled to equal weight, having failed in observing any such differences. The original object of my experiments embraced these, and all other questions which could be considered of importance; but I was not prepared for the very large number of experiments which has been required, and which greatly exceed what I had anticipated, and has involved a very large amount of labour, and occupied a proportionably longer time.

In the course of my experiments I have received much valuable information, as well as materials, from different gentlemen, whose names I shall afterwards have occasion to mention particularly, and whom I take this opportunity of thanking for their valuable

assistance in growing specimens for analysis, without which this investigation could scarcely have been made.

In my present paper I purpose to describe first the method employed in the analyses, then to give the details of the analyses themselves, and to conclude by pointing out the inferences which it would appear may be drawn from the numerical results.

Previous, however, to entering upon these questions, I am desirous of making a few observations on the amount of information which such analyses are capable of supplying, in order that I may at once guard against the deduction from them of conclusions which they do not fully warrant. I am the more induced to refer to this at the outset, because I have observed that there is a prevalent impression that such analyses are sufficient to supply *all* the requisite information regarding the feeding value of different foods, and to stand entirely in the place of those laborious experiments on animals to which I have already alluded. So far from this being the case, there is no question, among chemists and physiologists at least, that such experiments cannot be altogether dispensed with, but that chemical analysis, while it gives in itself much valuable information, ought to be looked upon as the basis of all such experiments, simplifies them immensely, gives them a precision and accuracy which they could not otherwise possess, and enables us to generalise on the principles of feeding. In order to render this distinctly intelligible, I must direct the reader's attention to some points connected with the general principles of feeding. I do not, of course, intend to enter here in full upon a subject so extensive, which could not be done justice to in the limits of one or many papers, but must confine myself to such points as will serve to illustrate the point in question, and to render intelligible the relative amounts of information which can be furnished on the one hand by analysis, on the other by experiment.

In order that any substance shall be suited to employment as food, it must afford to the animal a supply of certain chemical substances, among which nitrogen, (in the form of what are called albuminous or proteine compounds,) phosphoric acid, oil, gum, and sugar, are the most important; and it is customary to say that substances are valuable as food in direct proportion to the quantity of these nutrient elements which they contain. Speaking generally, this is no doubt true, and consequently the analysis which gives the highest amount of these substances, must be taken as indicating also the highest nutritive value; and there can be no question that it does give an approximation towards it; but the instant we come to look more particularly into the conditions and phenomena of nutrition, we perceive at once that it can be only an approximation which it gives, and that, too, in many instances but a distant one. This will be more readily understood by confining our attention to one individual nutrient element; and I

shall select for this purpose nitrogen, which is generally admitted to be the most important of all, so much so, indeed, that some chemists, and particularly Boussingault, have determined the relative feeding values of different substances from the proportion of this element alone, to the total exclusion of all the others. Whether they are in all cases perfectly correct in doing so, I shall not at present attempt to determine; it is certain, however, that a tolerably close approximation is obtained, so long as we compare with one another similar kinds of food. Thus, for instance, to suppose a case, if we had two varieties of turnip, one of which contained exactly twice as much nitrogen as the other, there is no doubt that their feeding values would be pretty exactly in the ratio of two to one. The same would likewise be the case if we compared with one another two samples of oilcake, or two samples of any other food; but if we compare a quantity of oilcake with a quantity of turnips containing twice as much nitrogen, does it follow that their feeding values shall be exactly in the ratio of one to two, that is, of the quantities of nitrogen which they contain? In so far as we at present know, it would appear that, in all probability, this is not absolutely the case; but that, while the quantity of nitrogen is a very safe indication of the comparative values of different specimens of the same kind of food, we require, for the estimation of different sorts of food, to establish a special feeding value for each individual class.

The cause of this peculiarity is dependent on the conditions under which the nutrition of animals takes place. Supposing cattle to be supplied with a certain quantity of nitrogen in their food, a certain fraction only of that which they receive passes into the tissues, and is converted into flesh. The remainder partly appears in the dung and urine, and partly escapes in the gaseous form, according to some law which is not yet understood. It must be obvious from this fact that, in order to have the means of instituting a perfect comparison between the feeding values of different substances, we ought to ascertain not only the amount of nitrogen which they contain, but also the proportion of that nitrogen which is assimilated by the animal. This proportion must necessarily depend on the conditions in which the nitrogen exists in the food, whether in an assimilable condition or not, and is also to some extent dependent on the state of the cattle feeding upon it. Nitrogen exists in the plant, not in one, but in several different states of combination; and we have evidence to show, that in these different states its nutritive value is not always the same, and even that in some conditions it possesses actually no such powers at all. Had we satisfactory experiments to show the nutritive value of all the different forms of combination in which nitrogen exists, and analyses determining the proportion of all these different compounds in various foods, a great step in advance would be made. It is possible that at some future period this may be done; but

in the present state of chemical knowledge it cannot even be attempted, and that on account of the extremely imperfect state of our information regarding the nitrogenous constituents of plants and animals—a subject which has hitherto defied the skill of the most accomplished chemists. Any attempt to define *all* the different forms in which nitrogen exists, would infallibly lead to most erroneous conclusions; but in the analysis of the turnip, I have distinguished between the nitrogen which exists in the soluble and in the insoluble state, which is quite as far as the present state of our knowledge will permit.

It must be obvious, from the consideration of all these facts, that where *complete* information is required regarding the feeding value of any substance, we must have first its chemical analysis, in order that we may know the proportion of valuable ingredients which enter into its composition; and, secondly, experiments on animals, which shall determine for us the proportion of these substances which pass into the tissues; in other words, their special values in the individual sort of food. This last *must* be determined on animals, and there is no possibility of doing it in any other way. In short, to develope fully the whole principles of feeding, analysis would have to be supplemented by experiment, and the special nutritive values of each food having been once determined, analysis alone would in all future cases be sufficient. Such experiments would require, however, to be very extended; and not only to be undertaken on a definite and uniform plan, but to embrace the feeding of all the different kinds of stock, as well as the phenomena observed at different periods of the process of fattening, as there is reason to believe that each species of domestic animal may have different powers of assimilation, and be capable of taking up and converting into flesh and fat different proportions of the whole nutrient elements of their food; or, to express it more simply, that the same quantity of food may go further towards the fattening of one species than another. The truth of this, which is only a probable, and not a certain inference, from our present knowledge, would itself require a long series of experiments on animals for its solution.

I have thought it right to refer, at the outset of this paper, to the importance of combining with such analyses as I now communicate, a series of experiments on animals. I am free to admit, however, that we are not likely to obtain such experiments until some of our great agricultural societies take up the matter on a sufficiently extensive scale. Such experiments, except on a very limited scale, are beyond the reach of a private individual, for they are not only laborious, but expensive. Without this, however, our knowledge of the principles of feeding cannot be made complete and perfect in all respects; but even with our present very imperfect information, we are able to make a certain use of analysis alone, and to deduce from them approximative conclusions

as to the relative values of the foods, although, of course, much less definite than we could do if all the facts which I have indicated had been established. To this point, however, I shall again return in the conclusion of this paper, when I come to the discussion of the analytical results, to which I shall now proceed.

Method of Analysis.

The object held in view in the analysis of the turnips was to obtain as much information as possible regarding the proportions of their *proximate* constituents, and I proposed at first to determine the quantities of all these substances, including gum and sugar. Some preliminary analyses, however, served to show me, that when so very large a number of turnips, amounting to some sixty or seventy different specimens, were to be analysed, it would be quite impossible to manage these with the ordinary resources of a laboratory. Where gum and sugar are to be determined, the whole processes of the analysis must be undertaken without delay, and must be completed at once, which would have required in this instance the constant attention of at least twelve or fourteen operators. Even could this difficulty have been overcome, I do not believe that satisfactory determinations of sugar can be made upon the turnip. An attempt was made to ascertain the proportion, in one case, by evaporating the juice to dryness, extracting with alcohol, evaporating the alcoholic fluid to dryness, and weighing the residue; this being the method usually employed in proximate analysis for the determination of sugar. The substance so obtained, however, was not pure sugar, but was found, by analysis, to contain 1.44 per cent of nitrogen, which corresponds to 9.17 per cent of nitrogenous matters. So that this process—and it is the most satisfactory we have—would have led to very fallacious results. After some trials, I fixed upon a plan of analysis, which will be best rendered intelligible by detailing the steps in the process.

As soon as the turnips had arrived at maturity, a certain number was selected of each sort, so as to give as fair an average as possible of the whole crop. This was always done by the grower himself. The number selected was generally five, sometimes only three. When these were received at the laboratory, the analysis was proceeded with in the following manner. The turnips were cut up, and a portion taken from each, in such a manner that we obtained a quantity of every part of the root. From this the following portions were taken, and always in such a way as to give a quantity from each of the roots employed.

1*st*, About 400 or 500 grains were accurately weighed in a small glass, which was then introduced into the water bath, and dried until it ceased to lose weight, which generally required from two to three weeks. The weight being then determined, the loss was water. The residue was then transferred into a plati-

num crucible, and burned at first at a very low temperature, and afterwards a stronger heat was given. The residue in this case gave the total amount of *ash* contained in the turnip.

2*d*, From 2000 to 3000 grains were carefully grated, and the mass subjected to pressure in a screw-press, so as to express the juice and leave the fibre. The cake of fibre was broken up in distilled water, and again expressed; and this process was repeated until the last traces of juice were got rid of. The fibre was then carefully removed from the cloth, introduced into a glass, dried at 212° until it ceased to lose weight, and its weight accurately determined. It was then preserved for purposes to be afterwards referred to.

3*d*, A large quantity (from four to five pounds) of the remainder of the turnips was cut into thin slices, spread out on flat trays of block tin, and dried at a temperature near that of boiling water. As soon as it had become sufficiently dry for the purpose, it was ground to powder in a mill, and preserved in stoppered bottles for the subsequent steps of the analysis.

By these preliminary processes there were determined the amounts of *water*, *ash*, and *fibre;* and a sufficient quantity of the whole turnips was got into a state in which it could be preserved until such time as the rest of the analysis could be taken up. By this method we were able to undertake a larger number of analyses than it would have been possible to do in any other way; for, had the attempt been made to effect the whole operations upon the moist turnip, it would not have been possible to get through the different operations with that despatch, which was required when turnips were coming in to the laboratory in considerable numbers at the same time.

Determination of the Constituents of the Fibre.

A certain quantity of the dry fibre was taken, and the amount of nitrogen determined by Peligot's process, which I have found to give extremely trustworthy results. The amount of nitrogen multiplied by 6.36, gives the quantity of albuminous or proteine compounds.

Another quantity was burned in a platinum crucible for the amount of ash.

A third portion was digested for some time with a dilute solution of carbonate of soda. The fluid was poured off, and an additional quantity added; the digestion repeated; and the second fluid, mixed with the first, was strained through a cloth filter. Hydrochloric acid was added in excess to the filtrate, and the precipitate of pectic acid collected in a cloth filter and washed. It was then carefully removed from the cloth, dried at 212°, and its weight ascertained. After this had been done, it was ignited, and the amount of ash which it contained determined. This weight, subtracted from the former, gave the actual weight of pectic acid.

The difference between the sum of all these substances and the total amount of fibre gave the proportion of woody fibre.

Determination of the Substances contained in the Juice of the Turnip.

I have already observed, that the particular method of analysis employed was adopted for the express purpose of avoiding the *direct* determination of the soluble constituents of the turnip. Their proportion, however, was easily got at indirectly by the analysis of the entire dry turnip, and subtraction from the quantities obtained of the quantities of the corresponding constituents contained in the fibre, which had been determined by its analysis.

In order to effect this, the large quantity of turnip, which had been partially dried and preserved in bottles, was introduced into the water-bath, and retained there until its drying was thoroughly completed.

One portion, amounting to about 100 grains, was exhausted with ether, the ethereal solution distilled off, and the residual oil dried in the water-bath until it ceased to lose weight.

Another portion was employed for the determination of the nitrogen, from which the total quantity of nitrogenous constituents was calculated.

A third portion was incinerated. The ash which remained, dissolved in dilute hydrochloric acid, filtered, and ammonia added to the fluid. The precipitate obtained was collected, washed, and weighed, and gave the amount of phosphates of the alkaline earths contained in the whole turnip. The filtrate was evaporated to a small bulk, and the residual phosphoric acid precipitated by means of a solution of sulphate of magnesia. The precipitate was collected and weighed, and from it was obtained the amount of phosphoric acid which had existed in combination with the alkalies.

As some phenomena connected with the disease of the turnip led us to anticipate some results from the determination of the sulphur, the proportion of this element was ascertained in a good many cases. This was effected by treating a weighed quantity of the moist turnip with strong nitric acid, digesting for some days at a temperature near 212°, and then adding powdered chlorate of potash to complete the oxidation. By this means the whole sulphur was converted into sulphuric acid, which was weighed in the form of sulphate of baryta, and for it the sulphur was calculated.

I did not attempt a more minute examination of the ash, as it appeared to me that the determination of the quantities of lime, magnesia, alkalies, &c., would not afford any information as to the feeding values, while it would greatly complicate the investigation.

Calculation of the results of Analysis.

The calculation of these analyses is somewhat complex. The first step consisted in calculating the amount of water on 10,000 parts, and then the amount of fibre. The quantities of dry fibre

employed for the determination of nitrogen, ash, and pectic acid, were next converted into their equivalents of turnip in the moist state; and from these quantities the proportion on 10,000 was calculated, and the nitrogen converted into its corresponding proportion of albuminous or proteine compounds. The difference between the sum of all their substances, and the total amount of fibre, gave the proportion of *woody fibre.*

In calculating the results obtained from the dry turnip, the quantity of moist substance to which it corresponded was first ascertained, and from this the amount of oil was calculated.

The nitrogen and its equivalent proportion of proteine compounds was determined in the same manner. This gave the *total* quantity of nitrogen in the turnip; and the difference between that and the quantity contained in the fibre, gave the proportion present in the juice. The difference between the sum of all these substances, including fibre, and 10,000, gave the proportion of gum, sugar, &c.

The proportion of ash and phosphates was calculated in a similar way, and the results are stated separately from the others; a method which I was compelled to adopt, from the impossibility of ascertaining to which of the constituents it is attached, and in what proportions. The quantity given at the bottom of each analysis expresses the total amount of ash, including that of the fibre.

Analytical Results.

The first series of turnips analysed were grown by Mr Finnie of Swanston in the year 1849. They were *White Globes*, and were sown on the 29th June, on a field the soil of which was very uniform throughout. The whole field was divided into thirty sections, to each of which a different manure, or mixture of manures, was applied. Unfortunately the turnip disease made its appearance to some extent; but its ravages were confined to a certain number of the divisions, while others entirely escaped. The turnips were raised on the 19th November, and the weight of each portion determined by Mr Finnie, and a certain number of turnips from each section selected, so as to give as nearly as possible a proper average of the whole.

Each was analysed exactly after the method already described, and in one or two instances a special analysis was also made of the diseased turnips, the diseased portions being selected expressly for that purpose.

No. 1.

White Globe Turnip, manured with 6 cwt. Ichaboe Guano.

Pectic acid,	79.0
Ash,	18.9
Protein compounds, containing 3.7 N.,	23.5
Woody fibre,	227.6
Total fibre,	349.0
Water,	9,364.0
Oil,	12.6
Protein compounds, containing 11.2 N.,	71.4
Sugar, gum, &c.,	203.0
	10,000.0

Ash,	64.0
Phosphates,	13.5
Phosphoric acid,	0.8

No. 2.

White Globe Turnip, manured with 6 cwt. Guano.

Pectic acid,	22.5
Ash,	7.0
Protein compounds, containing 1.12 N.,	7.1
Woody fibre,	102.4
Total fibre,	139.0
Water,	9,237.3
Oil,	11.5
Protein compounds, containing 15.07 N.,	95.9
Gum, sugar, &c.,	516.3
	10,000.0

Ash,	60.3
Phosphates,	11.7
Phosphoric acid,	0.3

No. 3.

White Globe Turnip, manured with 6 cwt. Guano.

Pectic acid,	64.0
Ash,	17.0
Protein compounds, containing 4.3 N.	27.4
Woody fibre,	251.6
Total fibre,	360.0
Water,	9,369.0
Oil,	8.0
Protein compounds, containing 10.5 N.,	66.8
Sugar, gum, &c.,	196.2
	10,000.0

Ash,	70.0
Phosphates,	12.3
Phosphoric acid,	1.0

No. 4.

White Globe Turnip, manured with 6 cwt. Guano.

Pectic acid,	72.0
Ash,	18.0
Protein compounds, containing 4.2 N.,	26.7
Woody fibre,	261.3
Total fibre,	378.0
Water,	9,318.0
Oil,	24.0
Protein compounds, containing 13.1 N.,	83.3
Sugar, gum, &c.,	196 7
	10,000.0

Ash,	67.0
Phosphates,	12.0
Phosphoric acid,	0.1

No. 4.—Diseased.

The same as the last, but the diseased portions selected and separately analysed.

Water,	8,988 0
Oil,	33.5
Protein compounds, containing 39.2,	249.7
Fibre, gum, &c.,	728.8
	10,000.0

Ash,	129.0
Phosphates,	29.0
Phosphoric acid,	1.0

No. 5.

White Globe Turnip, manured with 15 cwt. Horn-dust.

Pectic acid,	16.0
Ash,	13.0
Protein compounds, containing 4.0 N.,	25.0
Woody fibre,	287.0
Total fibre,	341.0
Water,	9,102.0
Oil,	20.5
Protein compounds, containing 22.5 N.,	143.0
Sugar, gum, &c.,	393.5
	10,000.0

Ash,	70.0
Phosphates,	18.0
Phosphoric acid,	0.17

No. 7.

White Globe Turnip, manured with 20 bushels Bone-dust.

Pectic acid,	42.0
Ash,	14.4
Protein compounds, containing 4.2 N.,	26.7
Woody fibre,	251.9
Total fibre,	335 0
Water,	9,313.0
Oil,	22.0
Protein compounds, containing 15.1 N.,	96.3
Sugar, gum, &c.,	233.7
	10,000.0

Ash,	77.0
Phosphates,	14.6
Phosphoric acid,	0 6

No. 6.

White Globe Turnip, manured with 6 cwt. Dissolved Bones.

Pectic acid,	76.0
Ash,	20.3
Protein compounds, containing 3.6 N.,	22.9
Woody fibre,	196.8
Total fibre,	316.0
Water,	9,273.0
Oil,	20.7
Protein compounds, containing 19.7 N.,	125.5
Sugar, gum, &c.,	264.8
	10,000.0

Ash,	76.0
Phosphates,	17.0
Phosphoric acid,	0.7

No. 8.

White Globe Turnip, manured with 10 cwt. Rape-dust.

Pectic acid,	42.1
Ash,	12.4
Protein compounds, containing 4.1 N.,	26.0
Woody fibre,	223.5
Total fibre,	304.0
Water,	8,987.0
Oil,	11.9
Protein compounds, containing 29.1 N.,	184.8
Sugar, gum, &c.,	512.3
	10,000.0

Ash,	77.0
Phosphates,	17.2
Phosphoric acid,	0.7

No. 9.

White Globe Turnip, manured with 6 cwt. Superphosphate of Lime.

Pectic acid,	148.9
Ash,	15.0
Protein compounds, containing 3.25 N.,	20.7
Woody fibre,	112.4
Total fibre,	297.0
Water,	9,469.0
Oil,	21.0
Protein compounds, containing 20.8 N.,	132.4
Sugar, gum, &c.,	80.6
	10,000.0

Ash,	59.7
Phosphates,	9.2
Phosphoric acid,	1.6

No. 10.

White Globe Turnip, manured with 10 cwt. Rape-dust.

Pectic acid,	39.0
Ash,	12.0
Protein compounds, containing 3.5 N.,	22.3
Woody fibre,	192.7
Total fibre,	266.0
Water,	9,427.0
Oil,	14.0
Protein compounds, containing 17.8 N.,	113.3
Sugar, gum, &c.,	179.7
	10,000.0

Ash,	73.0
Phosphates,	11.7
Phosphoric acid,	0.2

No. 11.

White Globe Turnip, manured with 30 cwt. Animal Charcoal.

Pectic acid,	24.5
Ash,	11.8
Protein compounds, containing 3.1 N.,	19.6
Woody fibre,	166.1
Total fibre,	222.0
Water,	9,355.0
Oil,	15.9
Protein compounds, containing 24.3 N.,	155.3
Sugar, gum, &c.,	251.8
	10,000.0

Ash,	78.0
Phosphates,	14.1
Phosphoric acid,	1.0

No. 12.

White Globe Turnip, manured with 3 cwt. Guano and 3 cwt. Dissolved Bones.

Pectic acid,	89.0
Ash,	15.0
Protein compounds, containing 4.4 N.,	28.0
Woody fibre,	202.0
Total fibre,	334.0
Water,	9,233.0
Oil,	17.7
Protein compounds, containing 23.6 N.,	150.3
Sugar, gum, &c.,	265.0
	10,000.0

Ash,	78.0
Phosphates,	15.0
Phosphoric acid,	1.0

No. 13.

White Globe Turnip, manured with 3 cwt. Guano, and 3 cwt. Superphosphate.

Pectic acid,	17.4
Ash,	14.0
Protein compounds, containing 3.7 N.,	23.5
Woody fibre,	279.1
Total fibre,	334.0

Water,	9,324.0
Oil,	10.6
Protein compounds, containing 16.8 N.,	107.0
Sugar, gum, &c.,	224.4
	10,000.0

Ash,	87.0
Phosphates,	12.7
Phosphoric acid,	1.2

No. 14.

White Globe Turnip, manured with 4 cwt. Guano, and 3 cwt. Rape-dust.

Pectic acid,	10.5
Ash,	15.5
Protein compounds, containing 5.2 N.,	33.1
Woody fibre,	299.9
Total fibre,	359.0

Water,	9,346.0
Oil,	26.0
Protein compounds, containing 21.0 N.,	133.7
Sugar, gum, &c.,	135.3
	10,000.0

Ash,	82.0
Phosphates,	16.8
Phosphoric acid,	1.2

No. 15.

White Globe Turnip, manured with 4 cwt. Guano, and 3 cwt. Poppy-cake.

Pectic acid,	45.0
Ash,	14.0
Protein compounds, containing 3.6 N.,	23.0
Woody fibre,	193.0
Total fibre,	275.0

Water,	9,479.0
Oil,	17.0
Protein compounds, containing 11.8 N.,	75.0
Sugar, gum, &c.,	154.0
	10,000.0

Ash,	62.0
Phosphates,	10.0
Phosphoric acid,	0.5

No. 16.

White Globe Turnip, manured with 4 cwt. Guano, and 3 cwt. Bone-dust.

Pectic acid,	72.4
Ash,	13.4
Protein compounds, containing 3.1 N.,	19.7
Woody fibre,	181.5
Total fibre,	287.0

Water,	9,145.0
Oil,	14.1
Protein compounds, containing 23.8 N.,	151.6
Sugar, gum, &c.,	402.3
	10,000.0

Ash,	63.0
Phosphates,	17.5
Phosphoric acid,	2.0

No. 17.

White Globe Turnip, manured with 2 cwt. Sulphate of Ammonia, and 3 cwt. Bone-dust.

Pectic acid,	86.0
Ash,	17.0
Protein compounds, containing 5.6 N.,	36.3
Woody fibre,	220.7
Total fibre,	360.0
Water,	9,494.0
Oil,	16.0
Protein compounds, containing 8.2 N.,	51.6
Sugar, gum, &c.,	78.4
	10,000.0

Ash,	72.0
Phosphates,	10.0
Phosphoric acid,	0.3

No. 18.

White Globe Turnip, manured with 2 cwt. Sulphate of Ammonia, and 2 cwt. Dissolved Bones.

Pectic acid,	35.56
Ash,	15.60
Protein compounds, containing 3.57 N.,	22.66
Woody fibre,	236.28
Total fibre,	310.10
Water,	9,193.00
Oil,	32.50
Protein compounds, containing 19.11 N.,	121.30
Sugar, gum, &c.,	343.10
	10,000.00

Ash,	41.46
Phosphates,	15.27
Phosphoric acid,	2.77

No. 19.

White Globe Turnip, manured with 2 cwt. Sulphate of Ammonia, and 3 cwt. Rape-dust.

Pectic acid,	26.0
Ash,	18.0
Protein compounds, containing 4.8 N.,	30 0
Woody fibre,	240.0
Total fibre,	314.0
Water,	9,145.0
Oil,	26.0
Protein compounds, containing 18.4 N.,	117.0
Sugar, gum, &c.,	398.0
	10,000.0

Ash,	72.0
Phosphates,	18.4
Phosphoric acid,	1.6

No. 20.

White Globe Turnip, manured with 2 cwt. Sulphate of Ammonia, and 12 cwt. Animal Charcoal.

Pectic acid,	68.0
Ash,	14.0
Protein compounds, containing 3.7 N.,	23.5
Woody fibre,	224.5
Total fibre,	330.0
Water,	9,409.0
Oil,	21.0
Protein compounds, containing 11.9 N.,	75.5
Sugar, gum, &c.,	164.5
	10,000.0

Ash	71.0
Phosphates,	12.0
Phosphoric acid,	0.4

[*To be continued in next Number.*]

LIST OF PLOUGHING COMPETITIONS *reported to the Society since November* 1850.

District.	Date.	No. of Ploughs	Extent.	Time.	Amount of Premiums.	First Premium and Society's Medal Awarded to
Aberdeenshire—						
Cushnie, Auchterless	Dec. 27, 1850	29	60 falls	in 5 hours	£3 12 6	Joseph Coutts, farm-servant, Netherthird.
Newhills Agricultural Association	Dec. 18, 1850	21	½ acre	in 5 hours	3 10 0	John Jamieson, Huxterstone.
Overtown of Tough	Feb. 18, 1851	30	⅓ acre	in 4 hours	3 0 0	William Milne, farm-servant, Tillyfour.
Westertown, Huntly	Nov. 29, 1850	34	60 poles	in 5 hours	3 5 0	John Stephen, farm-servant, Gibston.
Westhall	Dec. 12, 1850	33	1 rood 15½ poles	in 4¾ hours	3 10 6	Alexander Philip, Lewisk.
Argyleshire—						
Argyle and Knapdale Society ...	Feb. 13, 1851	23	½ acre	in 5 hours	4 19 0	Archibald Ferguson, farm-servant, Ballimore.
Dunollybeg, Oban	Feb. 28, 1851	18	¼ acre	in 4 hours	3 0 0	Dugald M'Kichan, Gallanachbeg.
Ayrshire—						
Carrick Farmers' Society ...	Feb. 26, 1851	49	1 rood Scotch	in 4 hours	3 12 6	James M'Kie, farm-servant, Balsaggout.
Downan	Jan. 29, 1851	31	1 rood Scotch	in 4 hours	3 16 6	Hugh Brown, Kilphine.
Galston Farmers' Society ..	Feb. 11, 1851	32	Rate of 1 acre	in 16 hours	5 8 0	Andrew Pollock, farm-servant, Sawerston.
Grongar Farmers' Society ...	Feb. 20, 1851	21	Rate of 1 acre	in 13 hours	3 14 0	David Lindsay, farmer, Townend.
Berwickshire—						
Lauderdale Agricultural Society ...	Dec. 28, 1850	26	2 roods 25 poles	in 6 hours	6 10 0	John Carrie, farm-servant, Newbigging Walls.
Primrosehill, Buncle	Dec. 13, 1850	18	3½ roods	in 6 hours	5 10 0	James Richardson, Marygold.
East of Berwickshire Farmers' Club, Fishwick ...	Jan. 8, 1851	17	¾ acre	in 6 hours	5 7 6	James Porter, farm-servant, Edington Mains.
Do. Do. Winfield ...	Jan. 3, 1851	24	¾ acre	in 6 hours	5 7 6	William Fulton, farm-servant, Winfield.
Chapelhill, Cockburnspath ...	Feb. 15, 1851	20	Rate of 1 acre	in 10 hours	3 3 0	James Fairbairn, farm-servant, Pathhead.
Upper District of Lauderdale Society	Feb. 18, 1851	36	2 roods 20 poles	in 6½ hours	6 5 0	Thomas Darling, farm-servant, Addinstone.
Buteshire—						
Bute Farmers' Society	Feb. 14, 1851	44	30 falls	in 3 hours	7 12 6	Hugh Crawford, Cranslagmorie.
Caithness-shire—						
Clyth, Latheron	Jan. 16, 1851	24	1 rood 30 p. 24 y.	in 4½ hours	3 15 0	John Miller, farmer, Weydale.
Dumbartonshire—						
Cardross	Jan. 17, 1851	18	45 falls	in 5 hours	6 10 0	James Mackinlay, farmer, Wester Ardoch.
Cumbernauld	Jan. 24, 1851	26	Rate of 1 acre Sc.	in 16 hours	4 17 6	William Anderson, Smithston.
Forth and Strathendrick Society	Feb. 13, 1851	26	Rate of ½ acre	in 8 hours	4 11 0	Robert Miller, Kilmaronock.

LIST OF PLOUGHING COMPETITIONS (*continued.*)

District.	Date.	No. of Ploughs	Extent.	Time.	Amount of Premiums.	First Premium and Society's Medal Awarded to
Dumfriesshire—						
Dinwoodie Green	Feb. 4, 1851	27	½ acre	in 6 hours	£7 10 0	Archibald Johnstone, farmer, Kirkton.
Murtholm, Langholm	March 5, 1851	20	½ acre	in 4 hours	3 15 0	John Lauder, farm-servant, Caulfield.
Edinburghshire—						
Borthwick Mains	Dec. 17, 1850	24	Rate of 1 acre	in 10 hours	4 0 0	John Baillie, farm-servant, Halkerston.
Clifton, Midcalder	Dec. 6, 1850	52	½ acre Scotch	in 7½ hours	10 0 0	Alexander Lyal, farm-servant, Broompark.
Edglaw, Carrington	Jan. 11, 1851	23	½ acre	in 5½ hours	4 10 0	Thomas Kerr, farm-servant, Carrington Barns.
Newbattle Society	Dec. 13, 1850	35	½ acre	in 5 hours	3 10 0	George Rutherford, farm-servt., Longerwood.
Prestonhall Farm, Whitehill ...	Dec. 27, 1850	25	½ acre	in 6 hours	4 13 0	Archibald Shearer, farm-servant, Whitehill.
Fifeshire—						
Beath Society	Dec. 11, 1850	21	½ acre	in 5 hours	3 3 0	John Blyth, farm-servant, Shields.
Crossgates Society	Dec. 13, 1850	18	½ acre	in 6 hours	3 5 0	Robert Kier, farm-servant, Balbougie.
East of Fife Society	Jan. 9, 1851	26	½ acre	in 5 hours	3 5 6	William Kilgour, farm-servant, Colinsburgh.
Haddingtonshire—						
Pinkerton Hill	Jan. 18, 1851	50	¾ acre	in 6 hours	3 7 0	Robert Ferguson, farm-st., Hedderwick Hill.
Kincardineshire—						
Durris	Dec. 3, 1850	35	Rate of 1 acre	in 10 hours	5 0 0	George Greig, farm-servant, Ashintilly.
Fettercairn Farmers' Club ...	Dec. 7, 1850	77	½ acre	in 5 hours	5 5 0	James Forbes, farm-servant, Denstrath.
Mains of Catterline	Jan. 21, 1851	32	⅓ acre	in 3⅓ hours	3 2 0	William Mason, Hilton.
Nigg Agricultural Association ...	Jan. 7, 1851	34	½ acre Scotch	in 5 hours	8 4 6	William Knox, farm-servant, Kincorth.
Lanarkshire—						
Old Monkland, Barony, Bothwell, and Cadder Society	Feb. 14, 1851	33	Rate of 1 acre	in 13 hours	8 10 0	William Stevenson, farm-servant, Lumloch.
Linlithgowshire—						
Bathgate Society	Jan. 16, 1851	32	Rate of 1 acre Sc.	in 14 hours	5 1 6	James Brownlee, Headlesscross Mains.
Whitburn Society	Jan. 28, 1851	22	Rate of 1 acre Sc.	in 14 hours	3 5 0	John Russell, Balgoend.
Peeblesshire—						
West Linton	Jan. 3, 1851	29	½ acre	in 7 hours	5 5 0	Archibald Borthwick, farm-servt., Broomlee.
Perthshire—						
Ballavarran, Kirkmichael ...	Mar. 25, 1851	17	½ acre	in 6 hours	3 0 0	John Farquharson, Straloch.
Blairdrummond and Ochtertyre Club	Jan. 8, 1851	28	⅓ acre Scotch	in 5¼ hours	3 14 0	William Cameron, farmer, Woodland.

LIST OF PLOUGHING COMPETITIONS (*continued.*)

District.	Date.	No. of Ploughs	Extent.	Time.	Amount of Premiums.	First Premium and Society's Medal Awarded to
PERTHSHIRE, *continued*						
Castle Menzies Farm	Feb. 28, 1851	37	½ acre	in 5 hours	£4 5 0	Alexander Small, farmer, Carse.
Craighall	Jan. 20, 1851	23	½ acre	in 6 hours	3 4 0	John Soutar, Mains of Rattray.
Dunira	Jan. 29, 1851	37	½ acre	in 5½ hours	4 0 0	David Harley, Strowan.
Faskally	Mar. 12, 1851	40	½ acre	in 7 hours	4 0 0	Alexander Macdougal, farm-servt., Faskally.
Glengarry and Glen Erochkie Farmers' Club ...	Mar. 17, 1851	16	Rate of 1 acre	in 10 hours	3 9 0	Finlay Forbes, farm-servant, Dalnacardoch.
Innerhaddan	April 3, 1851	16	½ acre	in 6¼ hours	4 1 0	William Forbes, farm-servt., Castle Menzies.
Logiealmond Agricultural Society	Mar. 5, 1851	15	Rate of 1 acre	in 10 hours	3 1 6	Alexander Menzies, farmer, Woodend.
Methven Agricultural Society ...	Feb. 27, 1851	21	2 roods 20 poles	in 6 h. 10 m.	3 2 6	William Storer, farm-servt., Westertown of [Cultmalundie.
Moulin Society	Feb. 25, 1851	16	¼ acre	in hours	3 3 0	David Fergusson, Ardgie.
Moulinarn	April 4, 1851	17	¾ acre	in 7 hours	3 0 0	Donald Fergusson, Dalcasson.
St Martins	Dec. 26, 1850	26	½ acre	in 6 hours	5 0 0	James Baxter, Melginch.
Strathardle, Glenericht, &c., Agricultural Association	Jan. 2, 1851	23	½ acre	in 5 hours	3 5 0	John Stewart, Boreland.
Tirinie	Feb. 20, 1851	43	½ acre	in 5 hours	4 0 0	John Macdonald, Dalrawer.
RENFREWSHIRE—						
Greenock and Inverkip Society	Jan. 23, 1851	18	31 falls 28 yards	in 3 h. 35 m.	4 1 6	William Warden, Kingston.
Mearns Agricultural Society ...	Feb. 4, 1851	22	Rate of 1 acre Sc.	in 18 hours	3 12 6	James Craig, Cleugh.
Rashycrook, Dargavel	Feb. 4, 1851	21	70 falls	in 8 hours	5 3 0	James M'Gill, farm-servant, Longhaugh.
Renfrewshire Agricultural Society	Feb. 7, 1851	41	Rate of 1 acre Sc.	in 18 hours	7 10 0	Mathew Gardner, Lincline.
ROSS-SHIRE—						
Balcony	Feb. 5, 1851	53	½ acre	in 5 hours	3 5 0	Francis Maclennan, Drummond.
ROXBURGHSHIRE—						
Melrose Farmers' Club	Jan. 25, 1851	38	½ acre	in 5 hours	5 7 0	James Fowler, Horselawhill.
Union Agricultural Society ...	Feb. 20, 1851	36	¾ acre	in 7 hours	12 10 0	James Tully, farm-servant, Lempitlaw, East-[field.
SELKIRKSHIRE—						
Selkirk Farmers' Club	Jan. 8, 1851	17	½ acre	in 4 hours	3 10 0	John Hill, farm-servant, Philiphaugh.
STIRLINGSHIRE—						
Logie and Lecropt Farmers' Club	Feb. 12, 1851	16	Rate of 1 acre Sc.	in 16 hours	3 0 0	Thomas Henderson, farm-servant, Myreton.
Plean Society	Feb. 12, 1851	16	Rate of 1 acre Sc.	in 17 hours	3 10 6	Wm. Muirhead, farmer, Pirnhall of Sauchie.
Polmaise	Dec. 26, 1850	15	2 roods 16 poles	in 6 hours	3 8 0	Thomas Duncanson, farm-servt., Polmaise.

In all, 67 competitions; 1903 ploughs; 1903 ploughmen; 3806 horses; £305, 2s. premiums, and 67 medals.

RETURNS of COMPETITIONS in SEED for CORN and other CROPS, held in the Year 1850.

District.	Seed exhibited in Competition by Growers to whom Silver Medals were awarded.		Number of Competitors.	Award.		Competitors to whom Silver Medals were adjudged.		Produce per Imperial Acre.	Weight per Bushel.		Date of Sowing.	Date of Reaping.	Ground on which the Prize Seed was Grown.		
	Names of Species and Varieties.	Qrs. | Quantity.		L.	s.	Christian Name and Surname.	Estate or Farm, and Post-Town	Qrs.	Lb.	oz.			Altitude. Feet.	Exposure.	Nature of Soil.
County of Renfrew.	Sandy Oats, ...	3	6	3	0	William Glen, ...	Hawkhead Mains, Paisley,	7 bolls	$43\frac{1}{2}$		March 21, 1850	Aug. 30, 1850	40 above level of Clyde.	S.	Stiff.
	Beans,....................	3	10	3	0	James Renfrew, ..	Mains of Blackston, —	10 —	$67\frac{1}{2}$		Feb. 22, —	Aug. 26, —		Open	Heavy.
	White Wheat, ...	3	8	3	0	Robert Langmuir,	Lonend, ... —	$13\frac{1}{2}$ —	$64\frac{1}{2}$		Oct. 25, 1849	Sept. 1, —	18 or 20 above Clyde.	Free S.	Light.
	Second American Early Potatoes, ...	$\frac{1}{2}$ ton	17	3	0	Jas. Foster King,	West Longhaugh, Bishopton,	10 tons.			Planted. April 10, 1850	Dug. Oct. 15, —	50 above Clyde.	N.	Light.
District of Buchan.	Early Berlie Oats, ...	3	11	2	0	William Bruce,....	[Mintlaw, Netherton of Auchtydonald,	5 2 bs.	44		March 15, 1849	Sept. 15, 1849	50	S.E.	Black land on yellow bottom.
	Perennial Rye Grass, ...	2	3	2	0	John Mackay, ...	Moss-side, Cortes, ...	2 6 bs.	22			Aug. 1, —	150	S.	Black mould upon clay subsoil.
County of Haddington.	Red (April) Wheat,......	10	4	2	0	John Slate, ...	Sunnyside, Prestonkirk,....	5	63		March 14, 1849	Sept. 10, 1849	200	N.	Clayey loam.
	Chevalier Barley, ...	10	5	2	0	T. S. Mitchell Innes,	Phantassie, —	$7\frac{6}{8}$	$58\frac{1}{2}$		March 26, —	Aug. 20, —	40	Level	Gravelly.
	Common Scots Barley, ..	10	3	2	0	James Murray,....	East Barns, Dunbar, ...	8	58		March 9, —	Aug. 14, —	100	N.	Clayey loam.
	Potato Oats, ...	10	4	2	0	T. S. Mitchell Innes,	Phantassie, ...	$8\frac{3}{8}$	47		March 24, —	Sept. 9, —	140	S.	Strong clay.
	Late Angus Oats,........	10	3	2	0	John White,......	East Garleton, Haddington,	$11\frac{1}{2}$	43		March 12, —	Sept. 3, —		N.	Retentive clay.
	Hopetoun Oats, ...	10	3	2	0	John Dods, ...	Pathhead, Dunbar,......	$5\frac{1}{4}$	43		March 13, —	Sept. 5, —	580	N.	Clay.
District of Wester-Ross.	White Wheat, (Essex,) ..	3	3	2	0	H. Innes Cameron,	Arcan, Dingwall, ...	$5\frac{1}{2}$	$62\frac{1}{2}$		Nov. 1848	Sept. 1849	6	N.E.	Clayey alluvium.
	Common Barley, ...	3	3	2	0	John Mackenzie, .	Inchvannie, —	5	56		April 10, 1849	Sept. 7, —	50	S.	Black gravelly loam.
	Sandy Oats, ...	3	4	2	0	Donald Macdonald,	Bridge-end, —	6	$43\frac{1}{2}$		March 12, —	Sept. 7, —	5	S.	Heavy loam.
District of Forres.	Chevalier Barley, ...	3	5	2	0	John Rhind, ...	Miltonhill, Forres, ...	5	58	12	April 22, 1849	Sept. 20, 1849	80	S.	Light sharp soil; sandy subsoil.
	Sandy Oats, ...	3	4	2	0	Robert Anderson,..	Cooperhill, —	$5\frac{1}{3}$	45		April 5, —	Sept. 2, —	250	S.	Sharp sandy soil.
	Late Angus Oats,........	3	3	2	0	Robert Anderson,..	— —	$5\frac{6}{8}$	43	10	March 25, —	Sept. 6, —	250	S.	Sharp sandy soil.
	Perennial Rye Grass, ...	2	6	2	0	John Rhind, ...	Miltonhill, —	3	27	5	May 18, 1848	Aug. 1, —	100	Partly N. and S.	Black loamy soil; clay subsoil.

REPORT ON THE SEED COMPETITIONS OF 1850.

The Committee appointed by the Highland and Agricultural Society of Scotland to examine the samples of Prize Grains lodged at their Museum, (and for which silver medals have been awarded supplementary to the local premiums,) have reported as follows :—

County of Renfrew.—The samples from this district are all good, especially the oats and wheat, which are very fine, and superior to those from the same district the previous year. It should be insisted upon that the name of each variety of grain be correctly given by the exhibitor, as it might be important for reference and observation to ascertain which kinds are best adapted for cultivation in the different districts. The discussions on the cereal grains, which took place at the Society's meetings last season, and which are published in the Society's Transactions, will facilitate the identification of the kinds.

District of Buchan.—From this district the Berlie oats are particularly fine, pure, and clean. The ryegrass seed, although not heavy, is clean and pure, and much superior to the prize sample from the same district the previous year. The Committee continue their former recommendation to this district to encourage the cultivation of other varieties of oats.

County of Haddington.—All the samples from this district are particularly fine; the April wheat and Potato oats perhaps not to be surpassed in the kingdom. The Committee notice the absence of any variety of white wheat, and also beans, from a district so suitable for their successful cultivation.

District of Wester Ross.—The wheat, barley, and oats from this district are all very good, clean, and pure samples of their respective weights. The excellence of the land suggests the cultivation of other varieties of these grains.

District of Forres.—The whole of the prize grains from this district are of superior quality, especially the Chevalier barley, perennial ryegrass, and Sandy oats. Considering the excellence of this district for the cultivation of barley, the growth of other varieties than Chevalier might also be encouraged.

General Observations.—The Committee continue their recommendation to local societies, to give consideration to the growth of tares or vetches, for seed, in those places suitable for their ripening. The consumption of foreign tares is considerable; but in quality they are inferior to home-grown seed: hence a ready market would be found for all that could be grown. Attention should also be directed to the encouragement of the growth, for seed, of the different varieties of peas.

Haddington is the only district from which April wheat has been received. The growth of this variety, as well as that of other spring varieties, is a subject well worthy the consideration of most local societies.

There are several sorts of seeds which might be successfully produced in this country—such as linseed, rapeseed, parsley, and caraway, which are at present imported in large quantities from the Continent; and the protective duty of 5s. per cwt. being still continued on all sorts of grass-seeds, suggests the increase of attention to their production, as they continue to be imported largely, and are all suitable to be grown for seed in this country.

REPORT ON THE CONSTITUTION AND STATISTICS OF THE FRIENDLY SOCIETIES OF THE COUNTIES OF ABERDEEN, BANFF, AND KINCARDINE.

By Sir JOHN STUART FORBES of Pitsligo and Fettercairn, Baronet.

[Premium—The Gold Medal.]

[THE tables published by the Society in 1824, for the guidance of Friendly Societies, and referred to by Sir John Forbes in his Report, though compiled with great care, and under the best professional advice that could at the time be obtained, have been proved by later experience to be in some respects incorrect, and unfit to be adopted as a safe standard. The Society has consequently resolved to cancel these Tables, and the Directors avail themselves of this opportunity to intimate their withdrawal. Recent authorities, though agreeing as to their inaccuracy, differ in regard to the data on which others should be constructed; but the Directors have much satisfaction in announcing that this important subject has, at their request, been taken up by the Institute of Actuaries, and is now under the consideration of that eminent body.—JN. HALL MAXWELL, *Secretary.*]

The working principle of assurances, so called, by which, with safety to the speculators, on the payment of a small sum by a great number of individuals, a much larger benefit is secured to the few amongst them who may be visited by some natural casualty, and to the whole upon events whose time of occurrence is uncertain, is one of the greatest boons which the genius of science has ever conferred upon man in his social capacity; and benevolence had applied it with considerable success to the industrial classes, long before it was discovered and admitted to be suitable to any great extent for those in a more independent station in life.

This power is obtained only by very elaborate calculations upon extended data, being applied chiefly to the recurrence of sickness and the arrival of death, the probabilities of which are ascertained with extraordinary nicety by careful observation of a vast number of cases. It is very common to undervalue these statistics as a sound basis for the schemes of such associations, but their importance may be estimated from the wonderful concurrence of two of the most extensive investigations yet conducted. Mr Neison made his calculations from the returns of the actual experience of Scottish Friendly Societies over a period of twelve years, and comprising nearly three million years of life. These have been compared with the accurate returns of the rate of sickness and death among the members of the Manchester Unity of Oddfellows.

The difference is only a very small fraction of an hour, though the comparison had reference to upwards of two hundred and forty thousand lives.

It is infinitely to the credit of the industrial classes of this country that their spirit of independence has induced them, in the midst of the fluctuations in their condition necessarily accompanying a high state of civilisation, freely to patronise for more than a century back every scheme which offered the slightest hope of securing to them their hard-earned savings in time of sickness, or making provision in event of their death for those at present dependent upon them. The Legislature was not behindhand in giving, through various Acts of Parliament, every encouragement to this valuable engine for ameliorating the condition of the industrial classes, but it must be confessed that their influential neighbours, whose position and information should have qualified them to advise and direct their movements, have not exercised in many cases a sound judgment and efficient control in guiding their efforts to the best advantage; and it is to be regretted that, until lately, there has been in some quarters an appearance of jealousy on the part of the great assurance companies towards the Friendly Societies, which is deeply to be deplored. Their objects are kindred, although the assurance for the upper classes, conversant merely with the accident of mortality, gets rid of the complicated element of a sickness scheme, and is therefore more easily subjected to precise formulæ.

Happily such a feeling is now very generally repudiated. The body of actuaries, who, incorporated in their institute, form a most influential and talented staff for carrying on the science of vital statistics, have given their benevolent attention to this humbler branch of assurance. Messrs Neison, Ansell, and others have contributed the valuable results of their very elaborate inquiries, and there can be no doubt that the attention now awakened to the subject will work out for Friendly Societies many important improvements in the arrangement of their tables, as well as the selection of their objects, and the general management of their affairs. It would be a very great improvement, and it is satisfactory to find that the idea is not obnoxious to some of the larger assurance companies, if they would incorporate with their other schemes the machinery necessary for carrying on a Friendly Society for the lower classes also. It seems as if we were now approaching a period, from the increased information available for insuring stability, when such a junction might be safely proposed. The advantages to the industrial classes from such a step are obvious, by securing the stability and security of their extended foundation, as well as cheap management and command of the best information, just as in the case of hospitals and asylums, where the machinery for the higher classes of patients is, at a

moderate cost, made available also for the lower; and the establishment of branches would, as in their present plan, embrace a wide circle. In like manner, between the advocates for savings' banks and the supporters of Friendly Societies, let there be no coldness. The savings' banks are important engines for advancing the great social principle of economy, and their vast success shows how congenial they are to the present state of society. The solitary accumulation of spare cash is a valuable way of preventing extravagance or luxury, and providing for any special object of anticipated expenditure; it counteracts to a great extent the reckless feeling which cash in hand is apt to produce in poor as well as rich, and supplies the nest-egg to which it is so pleasant to make periodical additions; but it is a very feeble and imperfect substitute, in cases of social contingency, for the mutual principle, which develops the only cheap and efficient plan of meeting them. The new schemes for deposit and accumulative assurance seem well calculated, when fully organised, to become popular auxiliaries to this great combination for the benefit of these classes. Let us then unite to present all these various facilities, in harmonious rivalry for support and favour, under a deep sense of the importance of the one great object which their several promoters ought to have in common.

Supported by the various Acts of Parliament for encouraging the establishment of Friendly Societies, a vast number were from time to time organised in all parts of the country. It was calculated, when the late act was passed, that there were not fewer than thirty-three thousand in existence, comprising above three millions of members, and drawing an annual revenue of nearly five millions of pounds sterling. No better proof can be asked of the indomitable resolution on the part of the industrious classes in this country to provide against an evil day—no better argument that the spirit of independence is not wanting, if the debasing tendency of the poor-law were kept in check by well-arranged and carefully supported institutions—for providing a substitute in time of need. This spirit is the more creditable when we regard the innumerable cases of failure against which it had to contend, rendering the task apparently hopeless of giving stability to the Friendly Societies among these classes, as contrasted with assurance among the upper classes, of whom not more than one hundred and thirty thousand are supposed at present to avail themselves of any provident institution.

As an illustration of this difficulty, a cursory glance may be taken at the history of these institutions, fostered as they have been by the Legislature. The expectation of life, at the age of eighteen, may be taken at from forty to fifty years; and surely it is expecting little of any Friendly Society, that it shall, at least, fulfil its engagements to its original members, receiving, as it is,

additions of young lives, making probably no demands upon its funds. Yet what has been the result of experience? Between the year 1792 and 1832, a period of only thirty-seven years, 19,785 Societies deposited their rules with the clerks of the peace, although, in 1836, of that immense number only 5409 had any deposited funds, so that nearly three-fourths might be considered bankrupts, having squandered the savings of their members, and failed to fulfil the promises they had made. Such was the state of matters among the older Societies of which we have the statistical details demanded by the Legislature; but the history of the secret societies, whose constitution prevented their tables from being sanctioned under the old acts, is unfortunately equally disastrous. The Manchester Unity of Oddfellows, which dates with the present century, has attained greater popularity than any other, and is affiliated all over the country, comprising about 3500 lodges, and nearly a quarter of a million of members. Its scheme of one central body, consisting of the grandmaster, deputy, and secretary, with nine directors elected at a general meeting of delegates from the districts, seems well calculated to maintain strict attention to rule among the local lodges: but their tables have been originally faulty; and though the lodges have not yet had an average duration of fifteen years, its affairs are embarrassed. In 1843 alone, 225 lodges were closed for want of funds, and the defalcation has been almost 100 annually since that date. Mr Neison subjected the affairs of the Unity to a strict investigation, and his pamphlet, published in 1846, proves that it would require three millions sterling at present to enable it to fulfil its engagements.

This is a melancholy picture for the philanthropist who looks at the amount of virtuous self-denial evidenced by their accumulations, which has been doomed in thousands of cases, at the moment of need, to rude disappointment; and the evil is only now becoming distinctly evident, its effects only beginning to be felt, as we are assured that out of two thousand societies in activity, whose affairs have been submitted to that eminent actuary, Mr Ansell, for investigation, during the last four years, he has found scarcely one solvent.

In Scotland, to which more particularly the present Report refers, and with regard to a portion of which—the counties of Aberdeen, Banff, and Kincardine—we must descend to particulars, matters are not in a better condition. The Highland Society came forward as early as 1824 to encourage, by the publication of tables, the establishment of Friendly Societies, and the report of their committee at that time formed the basis of a vast number of those institutions. These tables were carefully adjusted according to the best information available at the time, but further inquiries and improved statistical observations proved that they could not be depended upon. The Society, therefore, determined to procure accurate information on the subject; and, as a preliminary step,

the directors advertised a premium for the best and most approved report "on the Constitution and Statistics of the Friendly Societies in the counties of Aberdeen, Banff, and Kincardine, established for the benefit of the Rural Population, and the suggestion of the means best calculated to extend the operation and increase the efficiency of such bodies." This, therefore, is the subject of the present inquiry.

The district selected is in many important particulars of habits, interests, and objects, a sort of community; and that part of the country has certainly been remarkable for the energy and sober steadiness of its people, the number and usefulness of its social institutions, and the sympathy and good understanding which subsists between its different ranks, fostering and developing the sources of moral improvement among the industrial classes.

To give an exact account of the constitution and progress of the Friendly Societies in any district requires considerable investigation, as the public data, such as the Official Register, gives information, even in regard to their constitution, of only a portion, and no details of their progress, since the quinquennial returns of that portion are not digested or made available. We have no means of getting any accurate information regarding the state of these Societies in our district before the passing of the Act 10 Geo. IV. c. 56. A good many had undoubtedly existed from an early date, but they partook more of the character of charitable deposits, as their common name of "boxes" indicates, from which, at the discretion of the managers, sums were from time to time given to the members in distress, than of associations for mutual assurance, which gave a definite right to their members to a certain amount of relief under certain circumstances. Of these, in the beginning of the century, there were supposed to be about two hundred in Aberdeenshire alone, most of them organised after 1793; and over the country generally they are estimated to have comprised about one-eighth part of the population among their members. What a glorious movement in favour of a provident application of the surplus funds of the people, as a reserve against the casualties of age, sickness, and bereavement! What a guarantee, by deposit, for good order among the industrious classes!

How sadly was the picture soon to be changed! The great encouragement given by the Act of 1793 to the establishment of these institutions fostered their progress, and from that period the oldest of the existing Societies date their regular enrolment; but the want of statistical data upon which to found their schemes, the benevolent desire to render the anticipated benefits as large and as attractive as possible, their isolated and local character, which prevented them from taking enlarged views of their objects, and the reckless expenditure of their funds, which in many cases disgraced the management of their office-bearers, combined fatally

against this permanence; and it appears from the Highland Society's Report in 1824, that, except the Scottish Ministers' Widows' Fund, which commanded extensive support, and had engaged scientific attention to its calculations, few of the Benefit Societies could be said to be solvent.

A report was obtained by the House of Commons, in 1825, from a committee on the whole subject, and doubts were thrown out as to the accuracy of the Highland Society's Tables. Upon this report was founded the Act of 1829, which established the system of regulation, intended as a security for having the societies established on sure bases, and under the sanguine hope that this regulation would afford a guarantee for security. A great many new societies were organised on very much the same principles as formerly. The plan of registration was then to be carried out by a regular Government officer appointed for the purpose, and in the course of a few years above forty societies in Aberdeenshire, fifteen in Kincardineshire, and seven in Banffshire, were duly enrolled. These legislative arrangements were doubtless conceived in the best possible spirit, but data were yet wanting to provide a safe constitution; and the same causes of decay being still at work, the unfortunate supporters of the new schemes were doomed again to be disappointed. The reporter has not, after diligent inquiry, been able to satisfy himself as to the number of existing Societies, compared with those registered, at that time, the quinquennial returns not being regularly arranged and published; but there is too much reason to believe that not one-fifth of the Societies at one time in action in those counties are now available for the public.

It must also be remembered that though the registration of these Societies was an important step towards their better regulation, and might have been productive of most salutary effects, could it have been followed by continued supervision, it was looked upon with great and most groundless jealousy by many who, vain of the importance of exclusive management, eschewed all State interference, as they termed it; and from this cause alone, coupled with the state of excitement which prevailed over the country generally in 1830, many societies were hastily broken up. It has been already stated that, in the county of Aberdeen alone, there were at one time about two hundred Friendly Societies; but in that, as well as the adjoining counties, the secret Societies had the principal hold among the people. The prejudice against Government regulation already alluded to operated strongly, and the Oddfellows' Lodges occupied the principal place. These not only augmented the dislike to the regular societies, but, when the suspicion of the unsound state of the Unity gained ground, they contributed to increase the want of confidence in the principles of assurance generally. It is the belief of well-informed actuaries in

Aberdeen, that scarcely a sound and solvent Society now exists in the district.

With the exception of the mutual and operative associations, and the few remaining free-mason lodges, it is believed that no established Benefit Societies now exist in the city of Aberdeen. The evils of some of the substitutes, especially the Yearly Societies, as they are constituted in Aberdeen, will be touched upon in their proper place—suffice it here to say, that in that locality they have been ill arranged, have led to gambling, and prevented the growth of better schemes. In Huntly and its neighbourhood there formerly existed five Societies, none of which were registered. Though for many years they conferred the greatest benefit on the district, they are now all dissolved; and this failure is traced chiefly to the heavy calls upon their funds from dissipated members, brought into sickness and distress by their own vices. The claims of these unworthy recipients were litigated, but found good in law, which disgusted the well-doing supporters of these institutions, from the dread of similar abuses, and led to the dissolution of most of them in a few years—the savings' bank being now left as the only substitute, by mere deposits, for a proper provision against the accidents of life among the working classes.

In Peterhead, at the time of passing the act of 1829, twelve Societies existed, of which four were in operation of old date previous to the Act of Geo. III. c. 33, to which the other eight, in common with so many throughout the country, owed their origin. The original Societies partook more of the character of dispensaries for free-will offerings, and had existed for nearly a century previous to their being enrolled under that act. The other eight Societies of the date of 1829 were composed chiefly of masters and workmen of the different trades, and mariners, in classes, with the aid of some friends to the principle of assurance; but, after an existence of about thirty years, during which time their rules were constructed upon no well-ascertained data, the act requiring registration induced a somewhat minute examination of their condition, and it was found that they were all in an unsound state, from having paid habitually larger allowances than their receipts would afford—having neglected the obvious resource of Societies without regular tables to pay no more than each year's receipts would afford. Upon this a great excitement arose, fomented, undoubtedly, by the unsettled state of the country generally at that time; and a general rush was made at the funds, headed by the younger members, who, having paid in least, were likely to benefit most by the scramble, which ended in the dissolution of seven out of the eight Societies. By this disastrous measure, a sum of from £4000 to £5000 was distributed, but the annual division of £350 or more was sacrificed. It is curious to observe so practical an illustration of

the fable, as the dividends were quickly absorbed, and, in so many instances, spent in dissipation or other foolish objects, leaving the recipients certainly no better than they were. Of the Societies which survived this crash, two were kept up solely for the benefit of the decayed members. Two others, by submitting their affairs to inspection, and valuing the lives of their members, have been enabled, at allowances reduced to the rate the funds would afford, to keep their schemes in action: though their entrants have been few, advantage being now more generally taken of assurances in other forms. It was not till 1844 that an attempt was made to repair the loss sustained by the community in the failure of so many of these benevolent institutions. During that and the following year, three Mutual Assurance Societies were formed. The first numbered, last year, 167 members, and expended, during that year, £16, 8s. 6d. in sick allowance, and £10, 5s. for funerals; while the contributions of members were £504, 9s. 1d.; the second numbered ninety members; and the third, whose rates are lower, and the sick allowance last year only £5, has sixty members.

The labouring classes now very generally decline entering these Societies, on the plea that they cannot afford the contribution of 1s. 2d. per week, and, to meet that objection, two Provident Annual Societies have been established. They number respectively eighty and ninety members, who pay 3d. per week; and out of the contributions of 13s. last year, one of them returned 10s. 9d. at the end of it. Thus we find that only 473 persons, out of a population of upwards of 9000, avail themselves of these Societies; but even this measure of success, which is at least a foundation for further improvement, is due to the patriotic exertions of those who contributed these particulars, and have ever judiciously watched over the best interests of the community in Peterhead.

In Fraserburgh, there were formerly at least seven Friendly Societies, but a lodge of Oddfellows is the only one now in operation. It affords sick-allowance to its members. At Rosehearty, near that place, there were formerly three Societies—the Gardeners', Masons', and Shoemakers'—the first being now extinct. Of the two latter, the Masons' comprises about 200 members, and out of its contributions (4s. per annum, and payment for honorary steps of advancement) it pays, from the interest, allowances to orphans and widows, and decayed members, above seventy years of age, from 12s. to 16s. a year, according to Society rank. The Shoemakers' Society extends its benefits by 2s. 6d. annually to children under ten. The former has existed above a century, the latter about forty years; but neither appear to afford the amount of benefit which ought to be obtained from well-regulated schemes; and it is to be feared they are too often

made apologies for expensive conviviality. In the same district, at New Pitsligo, an old Society, established in 1793, whose rules have been revised and registered, exists, but, though carefully managed, and possessed of considerable funds, it receives scarcely any addition of members, and its utility is therefore confined to aiding the decayed members and widows. In the more remote parts of the county, a few Societies still exist—one in each of the parishes of Clatt, Towie, Kildrummie, and Heathdon—but they are on the most limited scale. At Alford, three were at one time supported, but they are now all dissolved. The last in existence extended its scheme to an allowance during sickness and old age, and to widows and orphan children under ten years of age, and a payment on death. They had a graduated scale of contributions, but they were inadequate to the promised allowances when young members ceased to join. The Buchan Hammermen Society still counts about seventy members, and possesses about £400 of funds; but it is represented as in a very depressed state, and verging on dissolution. Its scheme embraces widows' and orphans' allowances, sickness and superannuation, and their payments last year were nearly double their ordinary receipts. In the Ellon district there were four Societies: that at Ellon, instituted 1812, was dissolved 1841, with 102 members and £785 funds. Ellon Gardeners' and Masons' established 1816 and 1822 respectively, and dissolved 1847 and 1848, with £360 and £684 funds, and 100 and 112 members. The only reasons alleged for their dissolution are change of public taste, and fear of Government regulations.*

In Banffshire, besides those dispersed in the rural districts, there were at one time, and that not remote, seven or eight Societies in the town. They were generally connected with the corporation of the place, and originated in some degree from its exclusive privileges. When these corporations were abolished under the Burgh Reform Act, the members embraced the opportunity of dividing the funds. The infection of dissolution seems to have spread to other Societies, both in town and country. That in Aberlour was broken up by a majority of its members, and a protracted law-suit has ensued, while the funds have been either divided or dissipated. It is believed that only two now exist—the Wrights' Society at Buckie, and the Mason Lodge at Banff; and while in that town there are agents for no fewer than eighteen Assurance Companies for the higher orders, no helping hand is held out to the industrious classes, for

* The only Friendly Society existing in that district now is the Newburgh Shipmasters', established in 1799, to supply aid, in time of sickness, till sixty-five; thereafter an annuity, funeral expenses, and widows' and orphans' allowances. Its members are now reduced to thirty, its funds to £200, and its income to £30.

whom it is so much more difficult to exercise the self-denial necessary to provide for an evil day, to assist them in turning their little savings to the best account. The failure of so many of these institutions is traced by intelligent observers to deficient tables, convivial meetings, and the greed of appropriating the remaining funds by partition on dissolution. In Forgue and all the surrounding parishes, the Friendly Societies have been broken up, and the loss is much felt. A few Savings' Banks, such as those at Forgue and Gamrie, are the only depositories for the provident now in use.

In Kincardineshire the picture is no less gloomy. In Stonehaven alone, there existed at one time eleven Societies, of which two only were registered. Their names were,—The St John Masons, Solomon Gardeners, Redron Gardeners, Weavers, Farmers, Wrights, Hammermen, Youthful Vine, Fishers, Chapter of Royal Arch Masons, and Oddfellows. The whole are now dissolved, and their funds divided, which has caused a serious loss to the community in the funds distributed in time of sickness, though certainly these were not equal to what they might have been, had their schemes been all well conceived and well administered.

The most important Friendly Society in that county was connected with the royal burgh of Bervie; but it has not been proof against the change of times, and false laws of ill-adjusted tables. It was established in 1799, and in 1845 it was possessed of a diminished capital of £460. The contributions were graduated from 5s. at sixteen, to 15s. at thirty-five, and 2s. 6d. additional annually to forty-five. The allowances for sickness, 2s. 6d. weekly, first six weeks, &c.; 24s. widow's annuity; and 25s. for member's funeral. The slightest calculation will show the inadequacy of the funds under such a scheme, and the Society has been dissolved.

In Laurencekirk parish, two out of four have dropped within a few years, and the others are in a hopeless state of decline. An Annual Society was attempted for sickness allowance, similar to that still in action in the neighbourhood at Luthermuir, but it was abandoned, because the class for whose benefit it was intended did not support it. In Laurencekirk are also held the meetings of the Mearns-shire Farmers' Society. This Society has no sickness scheme—its sole object; the number of members is sixty-one; the widows thirty-nine; one-third of the contributions and entry-monies, graduated according to age, is added to the capital annually; the rest is divided; and, upon widows dying or marrying again, if they have children, it is divided among them up to the age of fourteen. They receive at present £9 each. This Society enrols few new members, most people now preferring some kind of life assurance. In Johnshaven, a fishing

village on the coast, there are still two Societies. The United Society was established in 1805, and has considerable funds; but its members have fallen one-half, and it now obtains few additions—numbering at present about 100 members. Its rules, passed in 1833, are well arranged. The entry-money is graduated; the quarterly payments, 1s. The benefits are for sickness;—old age, above seventy, graduated according to the time the party has been a member, with 15s. for funeral expenses, 14s. annually for widows, and 7s. for each orphan under seven years of age. The regulations as to stock and investment are judicious. The other Society has also a considerable fund, and about sixty members. A Female Society, on similar principles, was tried, but did not last long.

It may be mentioned that, though not specially connected with this part of the country, the important and wealthy association of the Scottish Ministers' Widows' Fund has its collectors in every presbytery, as has the Schoolmasters' Fund for similar purposes; and the Friendly Society for widows and orphans of the Scottish Episcopal Clergy, though embracing the whole communion, has its headquarters in Aberdeen. These are, of course, unconnected with the rural classes, and limited in their object; still their successful experience for a great length of time is a satisfactory proof that such schemes need only to be well adjusted, and consistently supported, to secure the benefits they are intended to confer.

This summary is not so full as might be wished, though it embraces all the principal places in the district; but it shows how much the Friendly Societies have decayed, which is further illustrated by the following list of those registered according to Act of Parliament at various periods. Until the act of last year was passed, only a quinquennial return was required; and as the result was not digested, and all were not qualified, or obliged to make it, the return afforded no satisfactory clue to the numbers in existence at any one time. By that act, however, these returns must be annual, and contain many particulars not before required; and as it is the determination of the registrar for Scotland to make it as complete as possible, we may hope that it will procure a very full account of their position.

Aberdeenshire.

No.	Name, Place, &c.	Date of Establishment when known.	Last date of Registration.
1.	Errol Friendly Society, ...	1829	—
2.	New Pitsligo Master James Forbes Oddfellows,	—	1830
3.	Scottish Episcopal Friendly Society, Aberdeen,	1793	—
4.	Echt Forbes Lodge of True Caledonians, .	1819	1850
5.	Skene Prince George's Lodge of Free Masons,	—	1830
6.	Methlic Friendly Society of Formartin Wrights,	1829	—
7.	Charleston of Aboyne Lodge of Free Masons,	1831	1846

No.	Name, Place, &c.	Date of Establishment when known.	Last date of Registration.
8.	Kincardine O'Neil Farmers' Friendly Society,	—	1831
9.	Ruthen Ploughmen Friendly Society, .	—	1831
10.	Braemar Highland do. do., .	—	1831
11.	Tarland Wrights' do. do., .	—	—
12.	Midmar Farmers' do. do., .	—	1840
13.	Finzean St Dedaun's Lodge Free Masons, .	1831	1846
14.	Glenkindy St Andrew's Lodge do., .	—	1831
15.	Alford Farquharson Lodge of Wrights, .	1831	1837
16.	New Aberdeen Friendly Society, . .	1831	—
17.	Birse Wrights' do. do., . .	1831	—
18.	Kildrummy do. do., . .	1832	—
19.	Aberdeen Mutual Assurance and do., . .	1832	1839
20.	Fairfield Ploughmen's do. do., .	—	—
21.	Tough Farmers' do. do., .	—	—
22.	Turriff Lodge of Gardeners' do. do., .	—	—
23.	Strathdon and Glenbucket Wrights' do., .	1832	—
24.	Ellon, do. do., .	—	—
25.	Ellon Gardeners' True Blue do. do., .	—	—
26.	Rosehearty Shoemakers' . . .	1832	1838
27.	Do. Forbes Lodge of Masons, . .	1832	—
28.	Do. Wrights' do. do., . .	—	1835
29.	New Pitsligo Hay, F. S., . . .	1798	1836
30.	Strichen Union Lodge Oddfellows, . .	—	1834
31.	Inverallochy F. S., ...	—	1835
32.	Longside Buchan Lodge of Oddfellows, .	—	—
33.	Buchan Lodge of Hammermen, . .	1827	1833
34.	Birse Male and Female Society, . .	—	1833
35.	Strathbogie Ploughmen Society, . .	—	1833
36.	Muir of Rhynie Free Gardeners' F. S., .	—	1840
37.	Tullich Free Masons of St Nathalich, .	—	1834
38.	Louach Highland F. S., . . .	—	1834
39.	Newburgh Shipmasters' F. S., . .	—	—
40.	Northern Endowment Society, . .	—	1840
41.	Gilcomston Union F. S., . . .	—	1832
42.	Peterhead Adam Lodge of Gardeners, .	—	1843
43.	Aberdeen Operatives' Mutual Assurance F. S.,	—	1837
44.	Do. do. Lodge of Masons, .	—	1837
45.	Do. Royal Military Pensioners of St Andrew,	—	1839
46.	Do. St Nicholas Lodge of Free Masons,	—	—
47.	Do. Rechabites Salford Unity F. S., .	—	1844
48.	Do. Grain Association, . . .	—	1847
49.	Do. Friendly Insurance Society, (Fire,)	—	1847
50.	Do. Upper Kirkgate F. S., . .	—	1835
	Banffshire.		
1.	Banff Operative Lodge of Free Masons F. S.,	—	—
2.	Do. Adam's Lodge of Gardeners' F. S., .	—	—
3.	Do. Total Abstinence Society, . .	—	1845
4.	Macduff St James's Free Masons' F. S., .	—	1839
5.	Botriphnie F. S., ...	—	1831
6.	Aberlour Journeymen's F. S., . . .	—	1834
7.	Gardenstown F. S., ...	—	1839
8.	Buckie St Andrew Operative Wrights' F. S.,	—	1846
	Kincardineshire.		
1.	Kincardineshire Ploughmen's F.S., . .	—	1832
2.	Stonehaven New Town Youthful Vine F. S., .	—	1833
3.	Do. Solomon Gardeners' Lodge, .	—	1836
4.	Inchmarlo Douglas do. do., .	—	1833
5.	Lawrencekirk St Lawrence Lodge of Free Masons,	—	1830

No.	Name, Place, &c.	Date of Establishment when known.	Last date of Registration.
6.	Laurencekirk Friendly Lodge of Wrights, .	—	1831
7.	Do. St Paul's Gardeners' Lodge, .	—	1831
8.	Do. F. S., or Gardenstown Caledonian Oddfellows' Lodge, . . .	—	1832
9.	Mearns-shire Farmers' Society, . .	—	1836
10.	Bervie F. S., ...	—	1831
11.	Do. Lodge of Oddfellows, . .	—	1832
12.	Johnshaven United Society, . . .	—	1832
13.	Drumlithie Weavers' F. S., . . .	—	1830
14.	Do. St John's Lodge of Gardeners, .	—	1832
15.	Fordoun and Auchinblae F. S., . .	—	1831
16.	Auchinblae F. S.,*	—	1831

Meagre though this table be, it presents some important points for illustrating our present inquiry. It has been shown that the period—about 1830, just after the passing of the Act establishing registration—was very disastrous for Friendly Societies, and a vast number were then broken up. At Peterhead, of which there is a distinct history, twelve Societies were then in existence, yet one only was registered under the act. Now, considering that within a few years fifty Societies were registered in Aberdeenshire alone, it is no exaggeration to suppose that two hundred and fifty or three hundred of these Societies existed about that period, which, after excluding the indigent portion of the population, would probably be an average of one hundred and thirty of the adult males to each Society, so that they must at that time have fairly supplied the opportunity of a benefit scheme for the wants of the community. It is true they were generally so unsound in their principles, and so ill arranged in their management, that it is almost a matter of congratulation that so many of them have ceased to exist, because they prove the strong desire on the part of the industrial classes for such a resource in time of sickness and old age, while their failure leaves the field open for better schemes, founded upon improved modern principles, to take their place.

It is proper now, after this summary of the existing state of these Societies in the district in question, to proceed to the second part of the inquiry—viz., "The suggestion of the means best calculated to extend the operation and increase the efficiency of these bodies." A glance may first be taken at the evils consequent upon the existing state of things, which may be best measured by a consideration of the loss the industrial classes suffer for want of a better system. The condition of these classes is peculiarly liable to fluctuations. Their position being near the bottom of the scale, they have less margin for a falling-off in their usual resources. It is painful to see a serious reverse of circumstances in the upper ranks of life, but the absolute wants of nature are likely to be supplied with less difficulty in these cases, from the remnants of a better condition, than among the lower classes,

whose best state aims at nothing more than the gratification of those wants. The smallest failure in the means of obtaining that supply precipitates them into an abyss of distress and privation; and every one knows the difficulty of recovering lost ground in such circumstances. It is, moreover, to be noted that, in that position in life, self-denial is a most difficult virtue. It depends in a great measure upon the exercise of the higher powers, which keep in subjection the lower principles of our nature, and which, from deficient education, the necessity of continual bodily exertion, and the absence of many sources of refinement which surround persons of a higher rank, are not brought into play amongst them. How obvious is the inference from these considerations, that, if the means of supplying these deficiencies and counteracting these defects—among which, undoubtedly, a well arranged machinery for stimulating economy in prosperity is one of the most powerful—be not provided for them, and pressed upon them, the industrial classes must be subject to the most serious privations and harassing anxieties.

The truth is now pretty generally acknowledged, that higher aims, and religious and moral habits, are best fostered and ingrafted on the minds of persons in these ranks, by first improving their physical condition. Set their minds at ease, and make their bodies comfortable first, you will find them naturally more disposed gratefully to entertain your lessons of virtue; and in politics it is but a slight extension of the truth involved in the common saying, "An hungry man is a discontented man," to argue that a man who has a certain deposit prepared for his contingencies is likely to be more solicitous about good order and the public welfare, than he who lives from hand to mouth, and feels no bond of interest with the constitution under which he lives.

Besides the absence of these good effects which are certain to follow from a well-arranged system of Friendly Societies, the positive evils which result are not few or unimportant. The determined efforts made by these classes for a century past to secure to themselves the advantages of independence, have been already adverted to, and had they been well directed and spiritedly supported, there can be no doubt that the alarming increase and demoralising effects of the compulsory provision for the poor might have been more effectually kept in check. It is very true that the usual effect of a high state of civilisation has to some extent diminished the hardy simplicity of our national character, and has made the application for aid from the funds of others appear a matter of course in circumstances in which it would have formerly been avoided as opprobrious and unjust: but nothing would have tended more to delay and mitigate that change than facility in securing another resource by timely fore-

thought. Add to this the misery of disappointment of the well-disposed insurer, who had looked to his fund in the Society as a sure stay in case of sickness, and a provision for those he loves in case of his early decease, and the shifts to which he has been driven for want of a secure resource, when so many are broken up around him.

To this allusion has been made in mentioning the Yearly Societies, the establishment of which, as generally managed, and now exemplified in Aberdeen, is decidedly injurious. It is not denied that, in the absence of a better scheme, if well managed, they will do some good, by the weekly collection of a certain sum for twelve months, and the repayment of the balance to the members after providing for the sick according to fixed rules—though, to have a proper control over the health of entrants, they should always, like the Operative branches, of the Edinburgh United Deposit Society, be in connection with a regular assurance scheme; but even then they lose the advantage of the accruing benefit as the life becomes older, and perhaps uninsurable. The most serious abuse is, when their funds are lent to the members at high interest with little discrimination, and the spirit of gambling tempts the managers to borrow for this purpose. In such cases they are frequently broken up with great loss to those who are securities for repayment.

The principal cause of the lamentable falling off in the number and support of the Friendly Societies, which has produced the evils we have been considering, is, undoubtedly, the incorrect basis on which most of them have been founded, and the innumerable failures which have in consequence occurred. This has originated in great part in the difficulty of constructing the requisite tables with sufficient security. The work of the actuary in arranging the foundation of the common assurance for the higher classes is simply confined to the calculation of life and its attendant ramifications, of redemption, surrender, &c.; but the essential constituents of a Friendly Society, the sickness tables, the favourite annuity to widows, and the various modifications of complicated casualties, introduce so great uncertainty that there is a speculative competition for popularity among insurers fatal to the success of a safe premium, even if the grounds of such a scheme were satisfactorily fixed. Hence the endless variety of rates which these tables exhibit, proving that, if some are safe, others, as experience has shown, are ruinously low.

This inequality is glaringly exhibited by an analysis of some of the common tables. The amount of entry-money is very often not graduated, and the quarter pennies very seldom are according to age; yet we find that, between the years of 20 to 30, the average duration of sickness is only 8½ weeks, while from 60 to 70 it is 77 weeks, and in the following ten years 205 weeks; and it

must be apparent that the Society which takes members without graduation at various ages must be acting unjustly to some of its entrants. If the lowest rate is correctly proportioned, the young members must be supporting the older; and if there is not a constant influx of new members, it must become bankrupt. In like manner, we find some Societies offer equal benefits, though their respective contributions are widely different in amount. This is apparent in many of these Societies where the same benefit is promised, in some, for 3½d. a week, for which others charge 5d.; and even the different lodges of Oddfellows, governed by a general directory, in some cases offer equally 10s. per week in sickness, £10 at death, and £6 to £10 on death of member's wife, while their payments vary from 4d. to 5d. and 6d., as proved by their Quarterly Report in January 1845.

Another great objection to the present mode of arranging these Societies, and a pregnant cause of their frequent failure, is the circumscribed and ill-distributed field which each of them generally occupies. Mr Neison's elaborate work on Life Statistics, and his pamphlet on the Oddfellows' Unity, in which he brings to bear the extended information already alluded to, obtained by premiums from the Scottish Societies, proves distinctly that the principles of assurance can be satisfactorily developed only on a large scale. If a local arrangement is necessary, he and Mr Ansell seem to agree that three hundred members constitute the smallest body with which it is safe to work; but the example of the Manchester Unity, and its prodigious success, in spite of incorrect tables, exhibits in a striking point of view the advantage of an extended basis with central management, and branches having certain definite powers.

The same researches bring out other important objections to the general system of calculating the various increments of their constitution. Mr Neison, from careful comparison, finds that there is an excess of mortality in Scotland as compared with England, while the ratio of sickness is just the reverse, proving that the one does not, as commonly supposed, follow the other, as effect does cause; and similar differences are observable between town and country residents at different ages. Nothing is so common as to apply general tables to particular trades, though different trades are subject to widely different chances; and the limited scale on which they are generally founded renders them liable to the vicissitudes of epidemics, or local predisposing causes. Nothing has been so fruitful a source of failure as the widows' survivorships and superannuated pensions; these have generally, contrary to the advice of Mr Neison, whose evidence in Parliament completely proves the evils of the practice, been mixed up with the other portions of the scheme. The consequence has been, that, in the majority of cases, though things have gone on pretty well

for the first thirty or forty years, while all the original members were comparatively young, and when sickness and premature death alone were to be provided for, the schemes proved inadequate when heavy annuities became exigible.

The improper expenditure of the funds cannot be overlooked in this summary of the causes of instability among these institutions, and this arises in many cases from the character of those who conduct them. Irresponsible, except to their own members, in a very confined circle, and probably possessing considerable influence, without any careful examination of the true principles of assurance beyond the study of another local club, perhaps equally hastily projected, the managers often squander the funds, in an attempt to render their scheme popular, by entertainments, processions, &c. These are certainly not the proper means of securing popularity for such institutions, however natural they may appear; and with regret it must be stated, that the influential classes, who have time and opportunity of informing themselves more correctly on the subject, have not only failed to originate or support well-founded Societies, and to second the perseverance and regulate the exertions of the order for whose benefit they are chiefly designed, but have given the weight of their names and encouragement to many based upon fallacious principles, whereby they have led on their neighbours in the certain road to loss and disappointment, instead of pointing out the errors of their schemes, and endeavouring to direct them in a more sound and satisfactory course.

Then there are the meetings at public-houses. On this point, the evidence before the Committees of both Houses, preparatory to the passing of the late law, though not uniform, decidedly turns against the practice; and though the Legislature has thought proper to leave it open, every new Society should undoubtedly prohibit them; and in some of Mr Neison's recent schemes this is made a fundamental rule. We all know the difficulty felt, especially among the class mainly supporting Friendly Societies, in resisting the temptations these houses hold out to conviviality, or worse; and to that we have to add the wish to support their friend the innkeeper, by whose cunning arrangement the Society is often originated entirely to procure custom. Mr Barlow's evidence is very full, and draws an appalling picture of the extent of this abuse, specifying one instance, out of many that allow beer-money out of the funds, where, in 1848 alone, upwards of £475 was spent in that way. It is truly remarked by an informant in our own district, that the *quarter-pennies* at the meetings for collection are often outbalanced by the *drinking-shillings*.

This monstrous absurdity becomes more glaring, when we contrast the dissipation that often occurs at these meetings with the habits of economy and self-denial which it is the professed

object of the institutions to foster; but it is, if possible, enhanced by the consideration that its indulgence is actually falsifying the very scheme which they produce for that purpose. This is strongly brought out by Mr Neison's ingenious and important paper upon the rate of mortality among the intemperate group of lives read before the Statistical Society, in which he states:— "From the age of sixteen upwards, it will be seen that the rate of mortality exceeds that of the general population of England and Wales. In the 6111·5 years of life to which the observations extend, 357 deaths have taken place; but if these lives had been subject to the same rate of mortality as the population generally, the number of deaths would have been only 110, showing a difference of 3·25 times. At the term of life 21–30 the mortality is upwards of five times that of the general community, and in the succeeding twenty years of life it is above four times greater, the difference, as might be expected, gradually becoming less and less. If there be anything, therefore, in the usages of society calculated to destroy life, the most powerful is certainly the inordinate use of strong drink." Mr Neison's high character as an actuary, and his previous invaluable contributions to the science of assurance, are sufficient guarantees for his accuracy in these calculations. In a statistical point of view, their importance cannot be exaggerated, as forming the foundation for another step in the modern system of accurate estimate and minute subdivision of risks, which will give to the moderate and self-denying, by a low rate of premium, the benefit of regular habits; whilst "they cannot be without valuable influence on the social, political, and religious condition of society." It is true they refer to those decidedly addicted to drinking habits, but we see how soon these affect the constitution, as the mortality is so vastly enhanced even at the age of 16–20, when few can be called confirmed drunkards; and there can be no doubt that what are called only "free or generous livers" indulge for the most part in practices directly tending to shorten life. It is to be hoped that this interesting inquiry may be extended without delay to Scotland, and the results adopted into insurance practice. Enough has been said to point out the direct tendency which any encouragement of such habits among the members of Friendly Societies has to falsify their own schemes, and the gross inconsistency of offering, by their constitution, a direct temptation to such indulgences. The notorious waste of money in what is termed management must also be classed among the causes of failure, though not so fundamental as erroneous schemes, &c. Surely the time is come when, for a benevolent object, other means of excitement may be made available than the expensive paraphernalia of banners and ermine robes. The extent of this abuse may be estimated from the fact that, in one branch of the Unity, comprising 14 directors, 297 lodges, and 17,059 members,

in 1844, the account for sundries was £10,497, 12s. 8d., or 150 per cent of the whole sick allowances; and in another, of 2800 members, management cost £1100.

These considerations are far from exhausting the subject of the evils resulting from the failures among Friendly Societies and their probable origin; but they will, at least, suggest some obvious and important remedies, though we may not be able to propose a counter-agent for each cause, and a correction for every consequence.

Let it never be forgot that the great object is to obtain the elements of simplicity and security, along with popularity, in our schemes. The first point to be attended to is the selection of suitable objects for the scheme. Mr Ansell, in his interesting work, and his recommendations to the committee of the House of Lords in 1848, limits these to—

1. Allowance to a member during sickness.
2. An allowance in old age.
3. A payment at death.

The Unity of Oddfellows support the following objects under their general constitution:—

1. Allowance in sickness.
2. Allowance to widows or widowers.
3. Allowance to travellers out of employment.

Mr Ansell's objects appear all most desirable, fairly within the scope of such associations, subject to fixed laws now well understood, the guiding circumstances of which are easily calculated; but it seems that, to make a complete economical institution to provide for the social wants of the industrial classes, some other provisions, under the guarantee of mutual assurance, may be added without complicating too much the scheme. Thus the Mutual Assurance Company of Aberdeen provides—

1. An allowance in sickness.
2. Annuities, either immediate or deferred.
3. Payment on death.
4. An allowance in case of fire; and,
5. A provision for medicine and medical attendance.

But not content with preparing the poor man, by a small periodical payment in advance, for meeting the great casualties of life, it applies practically in shape of an assurance bank the principle so well brought out by the House of Commons report of 1825, which contrasts in the following sentence the position of the depositor with that of the insurer: "Whenever there is a contingency, the cheapest way of providing for it is by uniting with others, so that each may subject himself to a small deprivation in order that no one may suffer a great loss. The savings of the depositor will support him but a short time in sickness, or even if he retain something for old age, after having provided for occasional illness; the annuity he can then purchase will be very

inferior indeed to that which he would have obtained if he had entitled himself to a share of the accumulated savings of all those who, having contributed to a superannuated fund for many years, have never reached an age to require it." It has been felt that it is a waste and abuse of the economical principle not to extend the principle of assurance to common deposits as well as regular premiums, and thus present, for the acceptance of the industrial classes, another mode of saving. This plan has been offered with the other schemes by the Mutual in Aberdeen, and adopted as the principal object by the United Deposit Society in Edinburgh, under the feeling that the annual premium, a single intermission of which forfeits all claim to the contingent benefit, is too stringent an engagement in many cases, especially for those classes whose means of subsistence are often fluctuating, and their circumstances seldom independent. The sums which have been forfeited by lapsed policies, from change of circumstances, even among the higher class of insurers, are unmistakable witnesses to much suffering, which is generally endured before the premiums are intermitted; and the plan adopted by these institutions is to allow the deposit upon a policy of any amount allowed by the act, and permit its withdrawal on certain fixed conditions, with a certain rate of interest. There is no doubt that the stimulus of the periodical settlement induces many to persevere, and the power of withdrawal, and the necessity of renewed certificate of health, though made as easy as consistent with safety, are apt to excite dissatisfaction; but there can be as little doubt that the principle of obtaining a greater benefit by combination among depositors as well as insurers, though it may require time to prove its advantages, is sound and must prevail.

The difficult calculations for annuities to widows are now generally kept out of these schemes. In a set of tables just issued by Mr Neison for Shropshire, we have—

1. Sickness allowance.
2. Deferred annuities, commencing at a certain age.
3. Payments at death.
4. Endowments for children reaching certain ages.
5. Medical aid and medicines;

the whole adapted for females as well as males.

The schemes and the funds belonging to them should be kept perfectly separate, in order to know which are working safely, and to give to the insured in each the exact benefit of the fund to which he contributes.

The position of each Society should be annually reviewed, and the lives calculated, in order to make good its ground, and immediately, by common consent of the insured, to retrace its steps if any fallacy occurs in the working of the schemes, that they may at all events keep their expenditure within their income. To this

object it is to be hoped the annual returns now required from the registrars by Parliament will largely contribute, and from the facility of accomplishing this expensive process by means of an experienced actuary, who should be connected with every large Friendly Society. This introduces naturally the next point to be considered, and perhaps the most important for giving permanence to these schemes—viz., the scale on which the associations are to be conducted. The anxious wish to foster them has been conspicuous in the fact that, in spite of the difficulty, amid the exciting struggles on party questions, to edge in purely philanthropic questions, benevolent men have contrived to get about a dozen of Acts of Parliament on the subject between 1793 and 1846; yet there has been no disposition to monopolise the direction. It is in truth a subject eminently requiring to be worked out by local exertion; but that renders it the more necessary for influential parties to take the lead, and give it the proper direction. The Societies cannot be safely and consistently worked upon a small scale. A largely ramified association, with a central directory taking charge of the money matters, to whom all points of calculation must be referred—but with ample powers to the officials in the branches, who should be members of the general meetings, to conduct local meetings, keep up the branch machinery, and press the general scheme—is the true system of conducting Friendly Societies with safety and effect.

There should, for the regulation of these central associations, be some fixed laws. The data for calculating all the simple branches of a useful scheme are now sufficiently ascertained, as already explained; and a certain degree of uniformity—a foundation for which, it is to be hoped, may be attained through the institute of actuaries—should be preserved among these great associations, which may be pretty numerous, provided they are established in the large towns, and worked by branches. A few general standard regulations, such as that no business be conducted in public-houses, should apply to all; and from the readiness we find on the part of the industrial classes, when any plans such as clothing societies, savings' banks, &c., are properly explained to them, to put confidence in those established by parties having influence over them, there can be no doubt they would soon be convinced of the benefit of Friendly Societies being similarly organised on a substantial foundation. The evils of Yearly Societies have already been explained, but as the object is by any safe means to promote forethought and economy, an annual sickness scheme, if it is found to be decidedly popular in a district, might be presented alternatively with the common sickness tables; but only, as in the case of the operatives' societies of Edinburgh and Glasgow, in connection with some of the large associations, where each member of the annual society was already insured in some other scheme.

The necessity of some strenuous and combined effort, for which the present moment appears favourable, to arrest the downward tendency of our industrial classes, if they are left to depend upon a state provision for pauperism, has brought forward many champions of their independence. In our own district, Mr Barclay at Knockleith, near Turriff, who is benevolently interested in their welfare, proposes the following system of raising a fund in connection with an approved scheme of benefit assurance, and coupled with a plan of registration for servants and rural labourers:—

1. Each agricultural labourer to pay into the fund 5s. every half-year, his master, whether landlord or tenant, depositing an equal sum.
2. The capital thus provided to accumulate for three years, after which the benefit scheme may come into action.
3. Respectability of character essential to proposal as a candidate, and admission to be by ballot.
4. Any member ceasing to pay for two years, to forfeit all claim to benefit.

Mr David Miln of Dundee, whose connection with the working classes makes him a competent judge of their position and wants, argues with much force the right and duty of the Legislature to pass a law compelling every labourer throughout the country to deposit a certain proportion of his wages in some properly sanctioned beneficial institution. For this he quotes the analogy of the soldier's pension, partly made up of reserves from his pay, and the regulations of various public bodies requiring such investments from their servants. This proposal has the powerful support of Mr Milne of Milnegraden, as a means of keeping in check the nearly overwhelming burden of the poor-rate; but it cannot be denied that any such compulsory arrangement would, in the present state of the country, meet with most powerful opposition.

There is reason to hope that the case of a voluntary movement on the subject is not thus desperate; but it must be commenced with due regard to sound principles, general combination of influence and benevolence in their support, and all the information which modern science can afford. Nothing can contribute more to secure these objects than the study of experience, and the observations of practical actuaries. Before closing this report, it may not be uninteresting or useless to enumerate the results of these on some of the most important points requiring direction. In regard to the objects to be undertaken by Friendly Societies, it has already been remarked that it is most desirable to accommodate all classes as far as possible. In regard to the sickness scheme, which is the distinguishing characteristic of these institutions, the practice has been too unbending. The annual premium, and even the entry-money, have often been made unvarying, whatever the age at entrance—the absurdity of which has already been shown: but Mr Neison has remarked that there is not the

slightest objection or obstruction to graduating the benefit, as well as the entrance and quarter money, in a way to suit all classes of members. He strongly advocates the adoption of a distinct period for the cessation of sick benefit, which he would fix at seventy years, and the substitution after that term of a deferred annuity. This plan he has adopted in his recent schemes, and it is much more satisfactory for the insured, and quite as economical for the association, as the clumsy though common plan of reducing the allowance in long-continued sickness, avoiding the difficult definition of sickness and fear of imposition at an advanced age.

The extreme difficulty in many cases of maintaining the annual payments under reverses of fortune, and the hardships of lapsed policies, have already been pointed out; whilst the desirableness of keeping up as long as possible the stimulus of periodical premiums and constantly increasing benefit is obvious. A scheme entitled "Accumulative Assurance" has been added to its various other objects by the Edinburgh Associated Deposit Assurance Company, which bids fair to meet this alternative. Upon this principle the sum insured can at any time be added to or diminished, and the premium reduced or increased in a corresponding fixed ratio, thus providing for the unavoidable fluctuations in circumstances, the fear of which has hitherto acted, in many cases, as a positive bar to insurance.

Upon the proper scale of such associations something has already been said. Tables founded upon general averages cannot, we are assured, be safe in the case of members engaged in a particular trade, which has its particular liabilities, nor in a peculiar and limited locality, nor to a very small number of members. The broad basis of an extensive and well-centralised association is the foundation Mr Neison desires; and the late act of Parliament gives every facility for such a constitution. Under the law as it stood previous to the passing of the Act 13 and 14 Vict., c. 115, the expense of registration was so great that few such associations would undertake it. This was one objection, besides a foolish idea of independence, which prevented the great Manchester Unity of Oddfellows from being enrolled; and one of the faults of its constitution, in conjunction with the great powers given to its separate lodges — inducing, as has been seen, ruinous waste of funds— was their extreme subdivision, giving, out of its 251,000 members, in January 1845, little more than an average of seventy members to each of its 3500 lodges. Three or four unhealthy members getting in will suffice to break down such societies. They are now thoroughly awakened to the evils of their constitution in these and other respects, and it is to be hoped that their late searching inquiries may lead to a thorough reform, which, though it might at first thin the order, would in due time enable them to fill the high destiny apparently awaiting them. "A quarter of a

million of men," says Mr Neison, "have now the opportunity of perpetuating one of the most useful institutions ever developed by the working classes of any country. Under proper regulations, it may be the direct means of elevating the moral and physical condition of a vast body of the rising generation, and imparting a social character and importance to the industrious and provident classes, which they have never yet acquired." It is perhaps too numerous and too widely extended to be easily managed; but the principle is good, by giving confidence, securing the means of cheap government, with regular scientific supervision, and counteracting the evils of local contingencies.* These schemes should therefore be carried out by large district associations, with central boards of directors in the principal places all over the country, simultaneously brought into action under influential patronage, with delegates from the different local societies, which would, by the new act, be certified under one of the Government actuary's tables, and thereby entitled to invest with the National Debt Commissioners at 3 per cent, and to give the power of bequeathing to the extent of £50 to the next of kin, without administration to their members.

The subject of tables is of the first importance, and certain actuaries are nominated by the late act to certify those selected by any Society applying for registration. The Legislature decided against sanctioning any particular set of tables as a model, or even a guide, and it seems generally to be allowed to have been a judicious course—not so much from the difficulty of obtaining a fair general average, the data for which are now so complete as to prove a wonderful coincidence when the calculations are made by different processes, but because of their not according with the contingencies even of very extensive local districts. This has been proved by the comparison of results in different associations; and in none is it more distinctly shown than between the Essex and Wiltshire societies, both for rural populations, established the same year, 1828, and both very numerous—the former comprising about 7000 members; yet through the years between twenty and seventy the rate of sickness in Essex is always more than 25 per cent, and at the advanced stages reaches nearly 600 per cent above that in Wilts, while the average is 40 per cent above that of England and Wales. In the two crowded city populations of Liverpool and Leeds the difference is equally striking—the difference against the former varying through the above-named ages from 13 to 79 per cent, and being greatest among the youngest

* Though the Manchester Unity has not yet proceeded so far as to procure a legal position by registration, it is satisfactory to find, from the proceedings at their great festival, they have taken that step with the sanction of an overwhelming majority. They probably constitute the next in importance of these great secret Societies. With 2000 to 3000 branches, and 120,000 members, they distribute annually from £100,000 to £150,000 to sick members, and £30,000 to £40,000 for funerals, with a capital stated at half a million.

lives. It is true, the evil effects of badly-constructed tables are not seen at first; but the day of reckoning must come, and the district under review has exhibited some melancholy pictures of the infallible results. It has been too common to go on recklessly dividing to the last farthing, until many cases end as in one of the mining districts, where a Society that had subsisted sixty years left at its dissolution the sad spectacle of 300 individuals, all above fifty years old, who had long paid into its funds, unable to enter any new society, and without the provision to which their providence had entitled them. This is a sufficient answer to the scheme of Government model tables, and those stereotyped forms so often recommended for Societies who consult actuaries, whatever their circumstances may be; but it is produced as a caution, not as a discouragement. Data sufficient can now be obtained in almost every part of the country to suit local associations, on a sufficiently broad basis; and if they are making any mistake, a frequent revision of their position will always enable them to stop in time to correct it.

A few other points in regard to the tables may be noticed, especially the division of Rural and Urban in large associations, such as the Oddfellows. Mr Neison's elaborate inquiry goes distinctly to prove that the average rate of sickness does not follow the law of mortality, upon which it has very generally been calculated. The reverse, as has been already stated, proves to be the truth, and the premium for sickness ought to be higher in the rural districts; but the difference is so small that those who are forming such associations are strongly recommended to put it out of view altogether, and make no difference on account of town and country residence.

The comparative rate of sickness in the two sexes is also a matter of some importance. In the Wilts society, sickness is greater by 50 per cent among females than males, and in Essex it is also very great. In the female Society at Mold it is the reverse. It is true that accurate statistics are not yet sufficiently developed as to female sickness, which renders the application of results more difficult; but the indiscriminate use of the materials for all Societies admitting females is dangerous. Mr Neison has recently, in the Shropshire tables, added 10 per cent to the ordinary female premiums.

The investment of funds to good account must also be attended to. When Societies are registered, they are entitled to 3 per cent for money deposited with the National Debt Commissioners The necessity of this rate to support their schemes may easily be shown. In the sickness scheme, a young man entering at 30 years has an equal chance of living 39 years as of dying sooner; that is, of 100 persons 30 years old, 50 will live to 69. To secure, then, £1 a-week for sickness during those 39 years,

£115 would be required, as the calculation of average sickness is 115 weeks; but if the money is lent on compound interest at 3 per cent, £68, 14s. 6d. will suffice. In like manner, to secure £100 at death, £37, 8s. 4d. is sufficient.

It is believed that these embrace the principal points suitable as details to be noticed in this place, and this report may be properly closed with a very few words on the national view of this subject. The stage of high civilisation brings, with its many blessings, the cursed tendency to selfish accumulation, for which it gives great facilities; but the power of a spirit of enlarged and truly philosophical benevolence has certainly gained ground of late years in this country; and we know well that although "the poor shall never cease from amongst us," paupers would not be seen—that is, those living on compulsory aid—if charity in the true sense had its perfect work amongst the upper classes, and independence, providence, and industry pervaded the lower. To expect a complete fulfilment of these conditions would be to look for a Millennium, but if we persevere in the right course, we may approach to it. Many stout hearts, thoughtful minds, and liberal hands are at work, and their labours will be blessed. Poor-laws, as commonly enacted, and other nostrums, appear as much to irritate as to allay the disease. Their office is chiefly to meet the awkward necessity which the selfish principle, when it has sway, imposes, of supplying the decay of active charity and honest independence, by awarding to one part of the community a compulsory provision from the means of another. The new law in this part of the country has wisely maintained the old system of refusing aid to the able-bodied; and if its provisions are faithfully carried out, while it provides for actual want wherever it finds it, it will call forth the voluntary principle for the care of all but helpless destitution. The Manchester Anti-Poor-Law Association is setting to work in one useful branch, by advocating self-supporting industrial schools and farms. The first object, undoubtedly, is to restore the simple spirit of self-reliance, a large remnant of which we find even so late as 1820, when the Highland Society estimated in their report the number of members in Friendly Societies at 2,000,000—certainly a large proportion of the population of that day. It is remarkable that from Manchester, which may be called the centre of the modern spirit of trade, tending to set every man's hand against his neighbour, the most powerful antidote has arisen in the Oddfellows' Unity, admitting about 40,000 members annually. That association, if it can only correct the fatal errors in its constitution, which its own inquiries have assisted in bringing to light, promises fair to act as a faithful pilot in the course of reformation. It should not be regarded as a charitable or money-giving institution. Its true object, and that of all Friendly Societies, is the sound principle of seconding the efforts of those who are willing to help themselves.

How many these formerly were is shown by the large proportion of applicants for legal support who had formerly paid into one of these funds; and it surely is the duty of those distributing that support not to draw from such a source, where it is still available, the utmost supply for the necessaries of life, but to leave the hard-earned dividend of self-denying independence to supply in part some additional comfort to helpless age.

Though that supply is the right of the assured, not a charitable donation, there is enough of work for all in their different departments. The materials for a fresh start are now, as has been already explained, ample, in the experience of past and existing institutions, and the writings of statists, about to be further augmented by Mr Neison's advertised treatise on the formation and management of Friendly Societies, and the forthcoming Recommendations, with the same object, to be issued by the Institute of Actuaries at the request of the Highland and Agricultural Society of Scotland. The great duty, then, of the influential classes at this moment is to circulate information, correct prejudices, and soothe former disappointment, preparing the way for a general move in this direction. In most districts some existing institutions can be found—and they are not wanting in that to which this report refers — deserving of being put forward, with such corrections or amplifications as modern improvements may suggest; and if properly patronised, they would soon command confidence and support.

It would be alike foolish and impolitic to hold out hopes of an immediate reformation through this or any other single institution: there must be many subsidiary schemes, such as clothing clubs, coal societies, soup-kitchens, for which the same staff of management in every locality would generally be found ready agents, to carry out the great principle of aiding those who show a good spirit by beginning first to help themselves. The really primary object, however, is to put in motion the great social system of turning assurance to account for meeting the visitation of casualties among the masses, thus putting the science of political economy to its noblest purpose. The first step is difficult to take; men's minds are slow to be convinced that great effects can be produced by small means judiciously employed. The work of regeneration will be gradual, requiring patience and perseverance, but the reward will be certain. It is not too much to predict, that, if the outline sketched above could be satisfactorily filled up, it would multiply a hundredfold the comfort of that class which is at once the most numerous and most interesting of the community; check the progress of the selfish principle, which threatens the disruption of society; and re-establish that good understanding between the different ranks of our people, which is more subservient to the maintenance of good order amongst us than a standing army.

REPORT ON THE COTTAGE ACCOMMODATION IN THE DISTRICT OF BUCHAN, ABERDEENSHIRE.

By Mr James Black, Factor on the Estate of Ellon.

[Premium—The Gold Medal.]

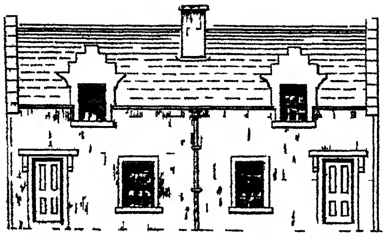
In reporting on the cottage accommodation of the District of Buchan, we propose to give, in succession, a short description of two different cottages: the former, as represented in fig. 1, Plate I., being taken from among the inferior grade; and the latter, as seen in fig. 2, Plate II., belonging to the superior or improved grade of this class of buildings; and concluding with a few observations on the habits and condition of the cottagers, and the means best calculated to amend them.

In fig. 1, Plate I., we have an exact drawing of a cottage at present occupied by three families, in actual existence, and a fair average specimen of the accommodation with which a crofter or tradesman of the humbler class, or a married farm-servant, is generally provided. The side-walls are scarcely five feet in height. The door, at the one side of which are piled up irregular blocks of stone to form a buttress to the wall, and prevent it from falling, is so low, that an ordinary-sized person on entering requires to bend considerably to the ground; and the gables, considerably above the level of the side-walls, are built with turfs, and do not even at the apex exceed the height of the side-walls above four feet. The whole mason-work is composed of undressed surface stones and mortar. An entire absence of every idea of comfort in the occupants is shown by the carelessness which has allowed the walls to be deprived to a great extent, through the influence of the drought and wind, of their cementing mortar, which at the first gave them a degree of compactness, and a power of resistance to the weather; but they are now quite open, and almost permeable by the wind in every part.

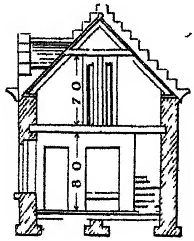
The roof of the house is covered with turfs, which are overlaid with straw; and above all may be observed quantities of grass-weeds growing up through the straw, and forming, by their decomposition, a very convenient receptacle for the lodgment of the rain from heaven.

The floor is depressed below the level of the surrounding ground, and is exactly the same material as the subsoil of the surrounding area on which the structure is raised. It is full of inequalities, arising from the nature of its composition, from defective drainage, from heaps of circumjacent refuse, and from the slovenly habits of the inmates. It is therefore frequently damp, and thus serves to augment the general discomfort. There are two small windows in front, each containing four small panes of glass. There is no ceiling. You see immediately above you,

INFERIOR CLASS OF COTTAGES

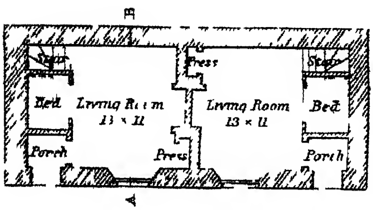


Elevation

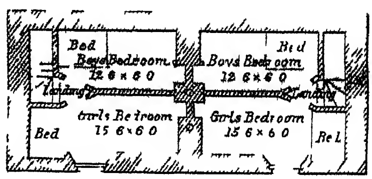


Section on AB

Scale
10 5 0 10 feet



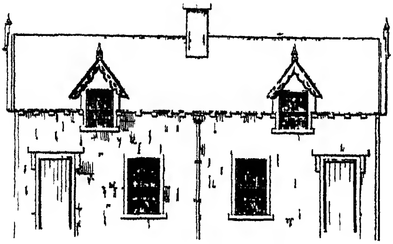
Ground Plan



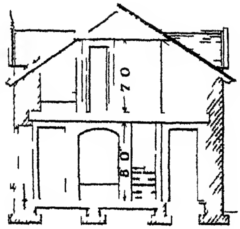
Attic Plan

Fig 1

SUPERIOR CLASS OF COTTAGES



Elevation



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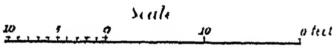
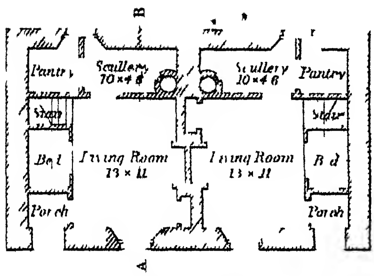
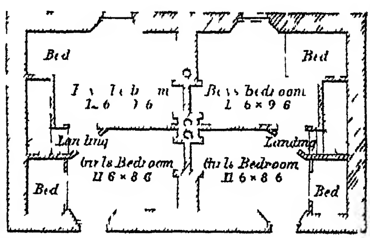




Ground Plan



Attic Plan

Fig. 2

W. & A.K. Johnston Edin.r

from the floor, the rafters and turfs densely covered with soot; and, in damp and rainy weather, giving off to the furniture below a copious covering. Nor is any attempt made at separate apartments by regular partitions. One or two bedsteads, placed in the middle, divide the building into two portions, familiarly denominated a *but* and a *ben:* in the one of which, being used as a kitchen, and, for this reason, the more comfortable of the two, the whole family sit and eat, and converse together.

The internal arrangements of the building are as defective as its construction. An air of discomfort pervades its whole interior. No regard has been paid in its construction to the principles of ventilation; and both its external and internal economy bespeaks the want of all ideas of order, cleanliness, and personal comfort. Above and beneath the bedsteads are huddled various articles of clothing, and of useless furniture, imparting by their decomposition a peculiarly offensive influence to the air, which is detrimental to health, and prolongs and aggravates disease.

Cottages of this description abound throughout Buchan. They are to be seen in some villages in the interior, in the extensive parishes of Old Deer and New Deer, and in Pitsligo, and in almost every one of the fishing villages along the sea-coast from the mouth of the river Ythan to the town of Fraserburgh. They are to be seen along the whole range of the Dudwick and Stirling Hills, which divide the parishes of Ellon and Cruden from those of Old Deer and Longside, and on each side of them, and along the edges of the moorland and mossy tracts of land which form so prominent a part of the outline of the parishes of New Deer, Strichen, and Pitsligo. In the more fertile and better cultivated portions of Buchan, a system has prevailed of augmenting the number of large farms; and, in consequence, diminishing that of the small. By the operation of this system, many of the small holders, deprived of their possessions, were forced to betake themselves to the improvement and cultivation of a piece of waste land on the side of a hill, or on the margin of a moor or moss, given them by the proprietor at a nominal rent for a stipulated number of years, seldom exceeding seven, and afterwards to be paid for at value. At the same time, the active spirit of improvement which recent years have witnessed in our farmers, and the common thirst for wealth, led to the removal from their farms of the cottars and subtenants, whose families had hitherto supplied the best farm-servants; and these also had no other resource left them but that of the crofters. Thus removed, these cottagers seem to have been more anxious to expend their little means on the reclamation of the ground allotted to them than on the comfort and convenience of their dwellings; even yet, these are almost all of the very worst description. Nor could they be otherwise. The cottagers were withdrawn from the intercourse and influence of the wealthy and

intelligent farmers. Their children were removed from the means of instruction; and while the parents were struggling hard to provide for their bodily wants, they were growing up without either moral or intellectual discipline, to prolong the habits and condition of their fathers.

From the reluctance which farmers have for some time shown to accommodate their married servants with houses on their farms, it not unfrequently happens that the families of such servants are also located in these situations. You come upon one of these miserable dwellings, which you find to be occupied by a female with several young children, and, on inquiry, ascertain that her husband is a farm-servant, on a farm perhaps several miles distant; that, by coming home in winter, and engaging as a day-labourer, he has contrived, when not otherwise engaged, to reclaim and improve as much of the waste land as scantily keeps a cow; that, in summer, he visits his family only occasionally; and that the whole labour of attending to the cow, of hoeing and harvesting, together with the cares of her family, devolve upon the mother. In these circumstances, much taste or comfort in the domestic arrangements of the family is not to be expected. The cottage they live in, at first rudely constructed, is uncomfortable and ill kept. The children are neglected in their education, and grow up to be thrown upon the world without any guide like that of moral or mental training to conduct them through its snares.

In the same localities are to be found many of the houses or huts of our parochial poor. Previous to the passing of the present Poor-Law Act, these dependants on public charity were frequently attracted to the vicinity of a moor or moss, their generally inadequate allowance from the church collections affording no guarantee either to farmer or heritor for the payment of a remunerative rent; and their residence on a farm or near a proprietary demesne being regarded rather as an eyesore than as a source of profit, they were allowed to erect for themselves, in these situations, such a structure—seldom other than rude and comfortless—as their means or credit would permit; while they enjoyed the additional advantage of a convenient supply of fuel. It is satisfactory, however, for the reporter to be able to state, that in several of the parishes of Buchan comfortable and substantial buildings have been, or are in the course of erection, for the accommodation of the poor. In the parish of Ellon there has been erected, at a cost of £330, such a building, consisting of two contiguous houses, each house containing eight apartments, and the whole planned and finished on the most approved principles as regards the health and comfort of those for whose convenience it was projected. Similar buildings are in the course of erection in the parishes of Old and New Deer.

In this district, the cottages which the farmers have hitherto furnished to their servants have been of the same inferior description. Few of the farmers allowed on their farms more than one such cottage. They were averse to the system of "hinding," as it is called; and, consequently, when a servant married he was under the necessity either of renting a room in some of the neighbouring villages, or of building a house for himself on some piece of waste land, away from the refinement of a cultivated locality. The natural result of this system was, that the families of our agricultural servants were brought up, in many instances, without the wholesome influence of the father. Besides this, when recourse was had for residence to a village, it was impossible for the parents, with their scanty means, and the high rate of living of such a place, to provide for their children anything beyond a stinted supply of their animal necessities; and the corrupt principles of our nature, from communication and contact with others in the same condition, were rather fostered in them than checked and subdued. In the retired corners of our extensive parishes, again, they were generally beyond the reach, even when they had the means, owing to the distance from our parish schools, of a sound, moral, and religious training. Hence one great cause, in this district, of the present low condition of our farm-servants. It will be in vain that we seek the abolition of our feeing-markets, and the diminution of our public-houses, if this system of rearing our farm-servants is to be perpetuated. Happily the farmers are awakening to the evils of it. Within the last twelve months several of our most intelligent and enterprising farmers have built, some of them three, and some of them two, according to circumstances, neat, comfortable, and commodious houses upon their farms, for the accommodation of married servants.

The residence of the families of married servants upon the farm, while it ought to be preferred by the parents, on account of the diminished cost of their children's maintenance, is equally desirable by them, as affording the best security for the moral and spiritual up-bringing of their family. It is also to be preferred by masters to the keeping of their servants in bothies. Married servants, having their families resident on the farm, are less given to change—are more moral and sober, from the presence of their families around them — are more studious of their master's welfare—and more disposed to regard their own interests as identified with those of their master, than unmarried servants, or married servants with non-resident families.

In fig. 2, Plate II., we have a representation of the improved style of cottages which the farmers in this district are now erecting for their married servants; as well as of the general style of cottages occupied by our more respectable tradesmen and crofters. Although a cottage of this improved style does not

occupy a greater ground area than one of the inferior sort, yet, from the greater height of the walls, and the better internal arrangements, the accommodation is greatly superior, and the comfort of living in it far more desirable. Here the walls are built of stone and lime. The windows, which are much larger than those of the former kind, are constructed so as to open and admit of a free circulation of air. The roof is substantial; it is perfectly water-tight; and is stob-thatched, tiled, or slated. A dry and comfortable floor of wood, or a composition of clay, is supplied. Two small but airy garrets, capable of being used as bed-rooms, are constructed above the two principal apartments into which the ground area is divided. While in the former sort of cottages there is no plaster nor ceiling whatever, in this the rooms are plaster-lathed and coom-ceiled; and altogether the appearance is much more pleasing. Ventilation, which forms so powerful a preservative of health, and indifference to which is so remarkable among the lower orders, is here also provided for. Connected with these cottages is generally a small garden. This useful and ornamental appendage, when tastefully laid out and carefully attended to, not a little enhances the good appearance of the cottage; while its presence and culture are powerfully conducive to the refinement of the taste and feelings. There is perhaps no service which farmers and proprietors can render to the cottager which contributes so much to his health and morals, and which is so well calculated to embue his mind with ideas of neatness and order, as the encouraging in him a taste for horticulture. Cottages like this, and even superior to this, are common throughout the extensive property of the Earl of Aberdeen—in some instances in poor and uncultivated moorland, where the occupants are busily engaged in bringing under tillage their respective allotments. They are also beginning to appear on the property of Mr Gordon of Ellon, and are not unfrequently to be met with along the sides of the public roads that intersect the district. They are principally inhabited by the more repectable crofters and tradesmen. As already stated, the cottages of the agricultural servants and labourers have, with a few exceptions, fallen considerably short as yet of this degree of perfection; but it is to be hoped that the example set by a few of our spirited farmers will be extensively followed.

Several plans for improved cottages have been published by those who are interested in the advancement of this department of architecture; but we prefer, for the accommodation of a single family, one similar to that which our second figure is intended to represent. It is the easiest of construction, and the cheapest of any. It is the most durable when well executed, and it is best adapted to the habits of the agricultural labourer or servant.

Those who occupy the inferior class of cottages in this district

are not generally characterised by intelligence.' This seems to have arisen in some measure from the extent of the parishes, which, as the population increased and cultivation was extended, gradually outgrew the means of instruction, while the position and circumstances of these cottagers rendered the advantages of our parochial school education unavailable by them. The extensive multiplication of schools, however, and the manifest improvements in teaching which the spirit of the age generally, and the influence of the Dick and Milne Bequests in these districts especially, have called forth, leave them perfectly inexcusable for neglect of this part of parental obligation. There is observable in many of them, notwithstanding, a lamentable indifference to the importance of a proper education to their children. It is consistent with the reporter's knowledge to state that, in not a few localities—some of them in the vicinity of schools conducted on the most approved principles—many prefer sending their children to old women and teachers of a very inferior grade.

The same cannot be said with respect to those who occupy the better sort of cottages: these are generally more intelligent, and much more sensible of the benefits of a thorough training in youth to the future wellbeing of their children. Many of them are well versed in subjects of history and theology, and you may occasionally observe in their houses several of our standard religious works—biographical, practical, and polemical; besides books of travels, &c. They are regular in their attendance upon church ordinances, and take a lively interest in the affairs of the communion to which they happen to belong.

All the cottagers in this district, both of the inferior and superior class, are, with inconsiderable exceptions, sober, industrious, and moral. They are known to regulate their affairs with much prudence and a wise regard to economy, and are faithful in fulfilling their obligations. By industry, sobriety, and good management, they contrive to feed and clothe often a numerous family, and to give them, in most cases, the elements of a plain education; and it is a well-known fact that many of our cottagers have, by their economy and industry, been enabled to educate their sons at our universities, and thus to open for them the path of honourable distinction.

Drunkenness is not a vice common among the cottagers of this district. It is rarely met with among the cottagers of the lower grade, and, where it does occur, is principally confined to tradesmen and artisans. It is needless to say what the consequences of this vice, when confirmed, are. They are uniformly the same. The cottage is ever found in a miserable condition both externally and internally; and the wife and children, where there are such, present a pitiable spectacle of famishing hunger and conscious degradation.

Drinking habits, however, have, within the last few years, become more common among our farm-servants and agricultural labourers. These meet in parties at the public houses on the Saturday nights, and continue drinking over the greater portion of the Sabbath day. Few of them are of provident habits. In one of the savings' banks of the district, embracing nearly seven parishes, and containing deposits to the amount of £6000, scarcely £1000 belong to these servants and labourers. They too often spend their wages on expensive Sunday clothes, on whisky and tobacco. They have become disregardful in many instances of church discipline, and neglectful of their illegitimate offspring.

To correct this growing evil, masters should foster and encourage, by every means in their power, a taste for reading in their servants and labourers. We know several farmers in this district who regularly supply to their servants a weekly newspaper and two periodicals, with the happiest effects. The experiment should be begun with light reading. Religious, or even historical reading, is generally unsuccessful till the desire for knowledge be awakened. When this desire has been thoroughly aroused, little else is necessary than to supply food for its gratification. Justices of the Peace should pay more attention to the granting of spirit-licences, and should be particularly cautious in the renewing of them. Masters should invariably dismiss servants found in a state of intoxication. A prudent firmness in the reprehension of such delinquencies is of much consequence; and he who heartily feels and earnestly desires the moral wellbeing of those around him, will consider no method too effective or summary for the punishment and repression of a vice so destructive in its consequences to personal and social happiness.

The improvidence which leads to an early and ill-advised marriage, the fruitful source of after misery, is common to the servants and humble cottagers of this district with those of other places. What the consequences of such a union will be to many of the present race of our farm-servants it is not difficult to foresee. With their acquired tastes and improvident habits, and living, perhaps, at a distance from home, the solemn responsibilities of this new relation will neither be felt nor duly discharged by them. We can point to several instances around us already of the truth of what we here surmise.

Of those who occupy the superior class of cottages there are but few who have not received the elements of both a secular and religious education. Many of them are good accountants, and can write a distinct and legible hand. Some of the tradespeople are really intelligent, and can discourse readily and sensibly on the passing topics of the day. All of them, with few exceptions, occasioned by intemperance, are attentive to the duties of religion in the observance of Sabbath and Bible ordinances. Yet much, even among these, remains to be done. We desiderate, even

here, a general increase of knowledge, and a deeper appreciation of the value of a proper attention to many of the material means of domestic comfort.

On the whole, we know not anything better calculated to elevate those of whom we have been speaking throughout these remarks, in the scale of moral and of spiritual existence, and to inspire them with a spirit of manly independence—accompanied as it would necessarily be with habits of order and attention to domestic happiness, so far as that happiness could be promoted by material means—than the cultivation among them, through the ministrations of religion, of an invigorating, manly, and consistent piety. But to effect any real and permanent improvement, we must begin with the young; and as one generation is the parent of another, it is especially with those who are to become the mothers of a succeeding generation that we should begin. Intellectual training does much, but it is not sufficient to complete the work of a perfect education. The heart must be trained; and, for this purpose, no influence is so powerful as that of the mother. The importance of female schools—the want of which has been so seriously felt and entailed upon a very important class of the present generation of the community, to the manifest injury of their best interests, physical, moral, and spiritual—is beginning to be appreciated. One or two of these schools have been established in each of several of the parishes in this neighbourhood, and appear to be conducted on the most enlightened principles; and laudable efforts are being made, in those parishes which are still without them, to procure their erection.

The plan of the inferior class of cottages on Plate I. is intended to accommodate two families, and would probably cost £70. And the plan of the superior class of cottages on Plate II. is also intended for two families, but would probably cost £100.

REPORT ON THE IMPROVEMENT OF WASTE LAND ON THE ESTATE OF BLAIR-ADAM, KINROSS-SHIRE.

By Mr ANDREW DOUIE, Factor on the Estate of Blair-Adam.

[Premium—The Gold Medal.]

THE estate from which this report is taken possesses few advantages either in point of soil or climate. The soil, for the most part, consists of poor and cold clay, very retentive, and full of large boulder-stones, with patches of moss of from 3 to 7 feet deep interspersed; the climate is moist, and the altitude from 400 to 700 feet above the level of the sea.

This estate, about a century ago, was a barren waste; but subsequently large sums of money have, from time to time, been expended on improvements, by a succession of public-spirited and enterprising proprietors, in making roads, in planting, in enclosing and draining, and in building comfortable and commodious farm-

steadings, to an extent almost beyond any other estate in Scotland of a similar size and locality.

In the year 1847, after the passing of the Drainage Act, the present proprietor of this estate applied for and obtained a grant of money for the purpose of trenching and draining. In the autumn of 1847 operations were commenced; and since that time 250 acres have been drained with pipes and with open drain-tiles and soles, the depth varying from 3 to 4 feet, and from 15 to 24 feet apart; and in addition to this, 155 acres have been trenched and drained, and brought under cropping. To the latter improvement the reporter proposes to confine himself in submitting the following statement.

In the subsequent detail I propose to arrange the lands into four divisions, and to report on each division separately. The number of acres in each is as follows, viz.:—

No. 1	division contains	40	statute acres.
... 2	...	41	...
... 3	...	42	...
... 4	...	32	...
		155	...

No. 1 contains 40 acres, in two contiguous enclosures, the soil of both fields being nearly of equal quality. The surface consists of 5 or 6 inches of black peaty earth, and the subsoil of strong clay mixed with stones. About fifty or sixty years ago the fields appear to have been partially brought under the plough; but since that time they have reverted to a state of nature, being full of wet—producing rushes, bent, and in some places heath; the lands renting for many years past at 7s. per acre.

In the winter of 1847, and spring of 1848, the fields were trenched and drained; the drains were cut 3½ feet deep, and 21 feet apart, and laid chiefly with pipe drain-tiles; the trenching was cut 16 inches deep, and also the stones above that depth laid on the surface. Lime was then applied at the rate of 160 bushels per acre, and ploughed in with a light furrow. The lands were then let to a tenant, on a lease of five years, at £2 per acre—three white crops to be taken in succession; the fourth year to be in turnips, manured with 12 tons of dung and 2½ cwt. of guano—the half of the crop to be eaten off with sheep; the fifth and last year to be in oats or barley, and sown down—the proprietor receiving back the fields in young grass.

Cost of trenching 40 acres, 16 inches deep, and removing all the stones above that depth, at the average rate of L.4, 15s. per acre,	L.190	0	0
Cost of cutting, laying, and filling drains, and price of drain-tiles, carriages, &c., cost L.7, 12s. 11½d. per acre,	305	18	9
Cost of lime,	160	0	0
Total expense,	L.655	18	9

Annual rent paid by tenant, ...		L.80 0 0
Deduct former rent previous to improvements, . .		14 0 0
Increase on improvement, 10 per cent on the outlay,		L.66 0 0

Tenant's return, per acre, on crop 1849:—

To 42 bushels oats, at 2s. per bushel, . .		L.4 4 0
Deduct for ploughing and harrowing, per acre,	L.0 10 0	
Deduct seed oats, 5 bushels, at 2s. 3d. per bushel, ...	0 11 3	
Deduct annual rent, per acre, . .	2 0 0	
		3 1 3
Tenant's profit, per acre, . .		L.1 2 9

Tenant's return, per acre, on crop 1850:—

To 45 bushels oats, at 2s. 3d. per bushel, . .		L.5 1 3
Deduct for ploughing and harrowing, per acre,	L.0 10 0	
Deduct seed oats, 5 bushels, at 2s. 3d. per bushel, ...	0 11 3	
Deduct annual rent, per acre, . .	2 0 0	
		3 1 3
Tenant's profit, per acre, . .		L.2 0 0

No. 2 *Division* contains 40 acres in one enclosure, and was trenched and drained in the summer of 1848. The soil of this field consists chiefly of cold clay, full of large boulder-stones, with the exception of about 2 acres of moss land, from 3 to 6 feet deep, the whole field being extremely wet. The work of trenching and draining was done by the day. In consequence of the depression of trade, and the want of employment in a manufacturing town in the neighbourhood, the proprietor engaged the unemployed operatives to do the work at 1s. 4d. per day, when about 130 were employed for several weeks, under the charge of three overseers. The field was trenched 16 inches deep, and the boulder-stones removed to that depth; the drains cut 3½ feet deep, and 21 feet apart, and, with the exception of the main or leading drains, laid with tiles and soles. The main-drains were finished in a most substantial manner, with built conduits 10 inches wide and 12 inches deep, and filled above with broken stones to within 16 inches of the surface. Patches of this field had, at an early period, been ploughed, but a great proportion of it had never been touched, the whole lying in a state of nature, producing nothing but rushes, bent, and grass of the coarsest kind, and renting at 10s. per acre. The following is the amount of outlay for the improvement of this field:—

To 41 acres trenching, 16 inches deep, removing stones, cutting, laying, and filling drains, 3½ feet deep, and 21 feet apart—cost of the whole, L.14, 16s. 10d. per acre,	L.608 9 8

In consequence of the work having been done by inexperienced workmen, the cost was thirty shillings per acre more than if it had been done by estimate.

In the spring of 1849 the field was ploughed with a light furrow, and was sown with Sandy oats, with two cwt. of guano per acre applied. The crop turned out excellent, and was sold by auction on the 28th August 1849, and brought the average price of £5 per acre. The following is the return from crop 1849, viz.:—

To 41 acres of corn and fodder, sold at L.5 per acre, ...		L.205 0 0
Deduct ploughing and harrowing, at 10s. per acre, ...	L.20 10 0	
Deduct seed oats, 30 quarters, at 20s. per quarter, ...	30 0 0	
Deduct 82 cwt. guano, at 10s. per cwt., .	41 0 0	
Deduct rent previous to improvement, .	20 0 0	
		111 10 0
Gain on improvement, being 15¼ per cent on the outlay, ...		L.93 10 0

In the spring of 1850, about one-half of the field received lime at the rate of 160 bushels per acre, and was ploughed in, and again sown partly with potato, and partly with Sandy oats, with the same quantity of guano (two cwt. per acre) applied. The portion of the field that received the lime was fully the best crop; but as it was late in the season before the lime was applied, it was not to be expected that the crop could derive much benefit from it in the first year. I have not, therefore, included the lime in the return for this year. The crop again turned out well, and the whole was sold by auction on the 12th day of August. The return from crop 1850 was as follows, viz.:—

To 41 acres of corn and fodder, sold at L.6 per acre, ...		L.246 0 0
Deduct ploughing and harrowing, at 10s. per acre, ...	L.20 10 0	
Deduct seed oats, 30 quarters, at 18s. per quarter, ...	27 0 0	
Deduct 82 cwt. guano, at 10s. per cwt., .	41 0 0	
Deduct rent previous to improvement, .	20 0 0	
		108 10 0
Gain on improvement, being 22½ per cent,		L.137 10 0

I may add, that both crops produced well, both as to quantity and quality. The produce of crop 1849 yielded from 50 to 55 bushels per acre; and that of 1850, so far as has been proved, yields from 54 to 60 bushels per acre: weight per bushel, from 39 to 40½ lb. For its accuracy I can vouch, as I had frequent opportunities of testing it.

Lime is to be applied in autumn 1850 to the remainder of this field; and in spring 1851 grass seeds are to be sown with the next crop. The field will then be kept in pasture for the three following years,

and afterwards ploughed for a crop of oats; the whole will then be in turnip, and eaten off with sheep, and, with the succeeding white crop, laid down to permanent pasture.

No. 3 *Division* is the adjoining field, and contains 42 acres, the whole of which was under a crop of oats in 1850, the trenching and draining having been finished early in April. About three-fourths of this field is hard clay mixed with stones; the other fourth consists of moss, from 3 to 5 feet in depth; the whole field being very wet,—so much so, that a person could not have crossed it dry-shod even in the driest season of the year. The pasture was very coarse, consisting of rushes, ling, bent, &c.; and but little of the field appeared to have ever been under the plough. The annual rent, 10s. per acre.

The trenching was cut 16 inches deep: all the stones removed to the surface. The drains were all cut 4 feet deep; and in the mossy parts 5 feet, so as to get through the moss—and laid with pipes, and open tiles and soles; and in many places wood was also laid in the bottom of the drains. The main-drains (as in *No.* 2 *Division*) were laid with built conduits, and filled up with broken stones to within 16 inches of the surface. The whole field was sown with oats in 1850; part of them Dun, part Tartarian, and part Sandy. All of the kinds turned out well. Two cwt. of guano, as in the former case, was applied to the acre, and three-fourths of the field were also sold by auction on the 12th day of August. The remaining fourth was retained by the proprietor, and was of equal value with what was sold. The expense of improving this field was as follows, viz.:—

To 42 acres trenching 16 inches deep, removing stones, cutting, laying, and filling drains 4 and 5 feet deep, at L.9 per acre, ...	L.378	0	0
Cutting outfalls, building conduits in main drains, and blasting stones, ...	64	19	3
Drain tiles, soles, and carriage of do., . . .	142	10	0
Total cost, L.13, 18s. 9½d. per acre, .	L.585	9	3

The following is the return, viz.:—

To 42 acres of oats, average price L.5 per acre, ...				L.210	0	0
Deduct ploughing and harrowing of 18 acres, at 10s. per acre, ...	L.9	0	0			
Deduct harrowing only of 24 acres, at 2s. per acre, this portion having been sown after trenching, without being ploughed,	2	8	0			
Deduct seed oats, 31 quarters, at 18s. per quarter, ...	27	18	0			
Deduct 84 cwt. guano, at 10s. per cwt., .	42	0	0			
Deduct rent previous to improvement, .	21	0	0			
				102	6	0
Gain on improvement, being 18¼ per cent,				L.107	14	0

The produce of this field will not be less than from 50 to 55 bushels per acre.

This field is to be managed, in every respect, in the same manner as *No. 2 Division;* other two white crops to be taken in succession, and the whole to be limed before being sown down. A little stable-yard manure is also to be applied to the thinnest parts of the fields.

It was at first intended to turnip the fields before sowing down; but, on consideration, it was thought better to lay them in pasture previous to green-cropping. The lands are not of that nature to run wild; and after three years' pasturing, they will then be properly consolidated, and more easily pulverised, and consequently in a fitter state for green crop.

The *Divisions Nos.* 1, 2, and 3, all lie contiguous. They contain 133 acres, and the soil of the whole is very much alike. It may not be out of place to mention that Nos. 2 and 3 were rather difficult of access, but the proprietor has remedied this by making a road through the centre of both fields, thereby opening them completely up for the carriage of manure and the removal of the crops from the different fields, as well as for access to and from an extensive tile-work which he has lately erected on the estate.

In regard to breaking up waste lands, I am of opinion that doing so with the spade is much preferable to the plough, and in the long run cheaper. In the one case you have the chance of a good return and a fair profit the first year; whereas, by the other, it is some years before you can calculate on any return. By trenching with the spade you at once clear the soil from stones, and also save subsoil-ploughing, which every one who has tried it knows to be a very heavy and expensive operation, seldom (if well done) costing less than £2 per acre.

In trenching with the spade, the plan I have sometimes seen adopted, of cutting the surface soil, or turf, about 6 inches thick, and laying it flat in the bottom of the trench, then throwing up 8 or 10 inches of subsoil on the top, is what I disapprove of. The preferable mode, in my opinion, is to cut the upper or surface turf about 18 inches broad and 10 inches thick, and turn it over into the trench, in the same manner as a plough-furrow is set; then throwing up about 6 inches of subsoil. By this method you have it in your power, by going deeper and deeper in every successive ploughing, to bring up the fresh surface-soil, which, being mixed with the original subsoil, gives a much greater stimulus to vegetation than in the other case, where the surface-soil is buried, and the cold unmixed subsoil kept on the surface.

No. 4 Division contains 32 acres, and is part of a farm on this estate, the tenant of which holds a life-rent lease. The soil is naturally good, but the improvement of it presented obstacles of such a nature, in the way of trenching and draining, as very

few indeed would have attempted to surmount. But the proprietor and tenant resolved that it should be carried through, the tenant agreeing to pay 6½ per cent on the outlay—although by a subsequent arrangement 5 per cent is the sum paid by him. The field is *locally* situated, being near to the farm-house, and close by an old castle, the country around being finely wooded. The soil is a strong brown loam, but was very retentive, and the subsoil was completely embedded with stones of a very large size, and so close together that it appeared as if at some early period they had been placed there by the hand of man.

The specifications for the work bore that the field should be trenched 18 inches deep, and the large stones above that depth should be removed by blasting, &c., and laid on the surface of the ground. The drains to be cut 3 feet deep and 15 feet apart, and a conduit to be built in the bottom of each drain 4 inches wide and 6 inches high, and to be filled up with broken stones to within 16 inches of the top.

The work was contracted for at £18 per acre, which was to include the whole work, and also the filling the stones which were not required for the drains into carts, for their removal from the field.

The contractor commenced operations in December 1847; but it was soon apparent that he must either lose a considerable sum by the contract, or execute the work in an imperfect manner. The latter alternative he appeared to adopt, and, in consequence, the contract was taken from him. As work of all kinds was scarce at the time, and as labourers could easily be procured, it was resolved that the work should be proceeded with by workmen hired by the day; and, accordingly, upwards of 100 were engaged at 1s. 6d. per day, and placed under the superintendence of the tenant, and two overseers under him. In this manner the whole work was completed by the 12th day of August 1848.

The cost of the whole outlay is as follows, viz.:—

Cost of trenching 32 acres, 18 inches deep, and removing stones above that depth, ...	L.576	0	0
Ditto of opening, laying, and filling drains with stones, and filling into carts stones not required for filling drains,	273	12	0
Do. of superintendence, ...	22	14	2
Or L.27, 5s. 2¼d. of outlay per acre, . .	L.872	6	2

Return on the Outlay.

Value of land per acre in its improved state, . .	L.2	5	0
Value of land per acre previous to improvement, .	0	10	0
Which gives on the outlay of L.27, 5s. 2¼d. per acre, or about 6½ per cent, ...	L.1	15	0

Tenant's return per acre on crop 1849 :—

To 54 bushels oats, at 2s. per bushel, .		L.5 8 0
Deduct for ploughing and harrowing per acre, ...	L.0 10 0	
Deduct seed oats, 5 bushels, at 2s. 3d. per bushel, ...	0 11 3	
Deduct value of land before improvement, per acre, ...	0 10 0	
Deduct value of land additional after improvement, per acre, ...	1 15 0	
Deduct for proportion of lime applied per acre, ...	0 15 0	
		4 1 3
Tenant's profit per acre, . .		L.1 6 9

Tenant's return per acre on crop 1850 :—

To 60 bushels oats, at 2s. 3d. per bushel,		L.6 15 0
Deduct for ploughing and harrowing per acre, ...	L.0 10 0	
Deduct seed oats, 5 bushels, at 2s. 3d. per bushel, ...	0 11 3	
Deduct value of land per acre before improvement, ...	0 10 0	
Deduct value of land per acre additional after improvement, ...	1 15 0	
Deduct for proportion of lime applied per acre, ...	0 15 0	
		4 1 3
Tenant's profit per acre, . .		L.2 13 9

The whole of the additional return on the improvement—viz., £1, 15s. per acre, or 6½ per cent on the outlay—is deducted from the tenant's return; for although he pays only 5 per cent, yet the work performed by him, in removing stones from the fields, and in carting earth on pieces of rock, was considered equivalent to the additional 1½ per cent. The straw is not taken into account, as the value of it goes to cover the expense of cutting, thrashing, and carrying the crop to market. The tenant applied lime in 1849, at the cost of £5 per acre, including carriage; and it is considered that the annual deduction from his profits of 15s. is a fair yearly proportion to be charged on his outlay.

In the spring of 1848, small patches of the field that were drained and cleared of stones in time were sown with oats, and produced a good crop. In 1849 and 1850 the whole of the field has been under oats. The field is now all limed, at the rate of 120 bushels per acre, and is again to be under oats in 1851, and the following year to be in turnip, eaten off with sheep.

Before closing the report, I cannot but take notice of some particulars connected with the trenching and draining of this field,

which may perhaps prove interesting; and the success attending the undertaking may perhaps have a tendency to encourage the improvement of waste-lands, even although apparently under discouraging circumstances. Nothing will yield a more certain return on money judiciously expended than the improvement of the soil; and surely nothing can be more gratifying to proprietors than to see their acres changed from a barren waste into fruitful corn-fields, and producing two blades of grass where one could not formerly live.

The appearance of this field now, compared with what it formerly was, is a strong proof, if proof is wanting, of the truth of my statement. It is now covered with the most luxuriant crops, the very reverse of what it formerly was, when it presented a most uneven surface, large boulder-stones protruding in all directions, water running over its surface, and the pasture produced of a very scanty and inferior description. The plough now does its work without the interruption of a single stone.

I may further state, that there are two principal outlets from the drainage of this field, which run into ponds constructed for watering cattle. A main-drain through a hollow, nearly in the centre of the field, was cut 6 feet deep, and 6 feet wide at bottom. A conduit is built in it 12 inches wide and 16 inches deep, and filled above with stones to within 16 inches of the surface. An immense quantity of stones were consumed in constructing this drain, and it was partly for that purpose that it was cut so large. The cost of it was two guineas per imperial chain. One advantage in the depth of this main-drain was, that, as the ground on one side of it was rather level, advantage was taken of the depth to cut the small drains running into it 6 feet deep, and, as they receded from the main-drain, gradually rising to 3 feet, thereby catching considerable additional fall to the run of the small drains.

In proof of the stubborn nature of the undertaking, it may be noticed that the blacksmith's bill for repairing and sharpening picks, levers, and jumpers, and including some new picks, amounted to £47, 18s. 0½d.; the expense for gunpowder for blasting, £38, 3s. 11d.; and for wright-work, £5, 10s. 6d.

It may be looked upon as somewhat incredible that a liferenter, particularly one who is well advanced in years, as the tenant of this farm is, should have entered with so much spirit into such an arduous and expensive undertaking. It is well known that liferenters in general are not the most forward in introducing improvements; but the late proprietor of this estate, who granted the liferent—for reasons which it is unnecessary here to state—with an enlightened policy far in advance of the times in which he lived, provided against this bar to improvement, by extending the liferent tack to the heirs of the liferenter, for the term of seven

years after his death. By this plan, the liferenter has it in his power to go on with improvements to the day of his death, in the full assurance that his friends will reap the benefit of his labours. Liferenters of farms are a race now nearly extinct; but whenever they occur, the above plan should always be adopted.

In conclusion, although somewhat foreign to my subject, I would only beg leave further to add, that, in the improvement of waste lands, the efficiency and utility of thorough-draining is the first thing that ought to be attended to. Much has been said, and much has been written, by the supporters of deep and of shallow draining, the one party contending for deep drains, placed wide apart, the other party equally keen in supporting a shallow system of draining, with double the number of drains put in—both parties, perhaps, advocating an extreme system.

If my landlord was to propose to drain my farm for me, and ask me whether I would prefer drains to be cut 2½ feet deep and 15 feet apart, or 3 feet deep and 18 feet apart, or 3½ feet deep and 21 feet apart, or 4 feet deep and 24 feet apart, I would, without hesitation, accept of the last. No doubt, in fixing the depth of drains, very much depends on the nature of the subsoil; but in all my experience I have uniformly found that drains cut 4 feet deep, and from 21 to 27 feet apart, insured the most permanent and most efficient drainage.

A shallow drainer ought to be aware that, if he examine his 2½ feet drains a year after they are cut, he will find his depth reduced to nearly 2 feet. This is particularly the case in mossy soils. I have seen drains cut 4 feet deep in moss, which in a short time required to be lifted and deepened 2 feet in consequence of the subsidence of the moss. This is one reason for cutting deep drains which is but seldom adverted to, but it is one which ought to be taken into account.

The accounts of the outlay have been taken from my books, and the amount of the returns from *Nos. 2 and 3 Divisions* from the roup-rolls. The value of the lands, both before and after the improvements, is also correctly given, as well as the returns of the quantity, as well as quality, of the crops—the whole of which have come under my personal observation, and can be satisfactorily vouched.

DESCRIPTION OF A PLAN OF FARM-BUILDINGS.

By Robert Bell, Esq., Architect, Edinburgh.

[Premium—The Gold Medal.]

The accompanying plan is designed for a farm of 500 acres, under a six-course rotation, situated in an arable district, where the straw and green crops are consumed on the farm.

1. GENERAL REFERENCES.

The following table explains the accommodation, and shows the length and breadth of each apartment, the height of walls above the ground floor, and height of roof above side walls.

No.	Description of Buildings.	Length.	Breadth.	Height of walls.	Height of roofs.
		ft. in.	ft. in.	ft. in.	ft. in.
1.	Potato house—with cart and barrow entrances, the latter for the convenience of farm house, boiling house, and piggeries, ...	48 0	18 0	8 6	7 4
2.	Loose-house—having an entrance from the stable and court, so as to suit other purposes if required,	10 0	18 0	8 6	7 4
3.	Shed for young horses, ...	19 0	13 0	8 6	5 8
4.	Do. for young cattle, ...	19 0	13 0	8 6	5 8
5.	Small cart-shed, ...	20 0	17 0	8 6	7 0
6.	Riding-stable, with corn-chest in bossing of window, ...	18 0	17 0	8 6	7 0
7.	Large stable. Being apart from dung-pits, is preserved from damp, with proper means of preserving cleanliness and complete ventilation without subjecting the horses to direct draughts of cold air, and is conveniently situated for the supply of provender, ...	78 0	18 0	8 6	7 4
8.	Harness-room and loft. The harness-room is intended for spare harness and stable utensils; and, where the corn from the chests is measured out for the horses, the loft is intended for two stable beds,	10 6	10 6	8 6	7 4
9.	Hay-house and loft. The hay-house is conveniently situate for stable and stackyard. The loft is intended for the storage of horse-corn, &c., with entrance from stable and granary, . .	18 6	17 0	15 0	7 0
10.	Cart-shed and granary. The cart-shed is connected with the implement-house, for holding carts, frames, harrows, rollers, &c.; the granary is connected with the corn-barn and bruising-house, with hatchway in the floor for loading carts with grain,	41 0	17 0	15 0	7 0
11.	Bruising-house and loft, ...	19 0	10 0	16 0	7 8
12.	Corn-barn and loft. The corn-barn has many advantages, in point of situation, is of easy access both from the clean court, stackyard, bruising-house and straw-barn. The loft is intended for the storage of unthrashed corn, and should in all cases be made large enough to hold one stack,	46 0	19 0	16 0	7 8
13.	Straw-barn, with loft. The straw-barn is conveniently situated for the deposit of its contents in various directions, and is sufficient to hold two stacks of straw. The loft, 41 × 17 feet, is intended for a straw-cutter, having a hatch in front of the shaker for retaining straw, and a door from loft to the shed for the disposal of the cut straw. The machinery of the straw-cutter and grain-bruiser is driven by a connection with the thrashing-mill machinery, . .	70 0	17 0	15 0	7 0

TABLE—(*Continued.*)

No.	Description of Buildings.	Length.	Breadth.	Height of walls.	Height of roofs.
		ft. in.	ft. in.	ft. in.	ft. in.
14.	North cattle-shed, ...	38 0	12 0	8 0	6 9
15.	Turnip-house. The turnip-house is conveniently situated for supplying the byres and boiling-house with turnips, by means of a continued line of railway along the side of feeding boxes, and extending to the cut-straw shed and stackyard, where a large storage of straw and turnips can be provided. The straw in straw-barn to be supported over the rails by means of a portable frame of wood, in the form of a mason's truss, when required, ...	36 0	28 6	8 6	9 8
16.	Stall-byres. The urine from the stall-byres to be made to flow through a drain from the channels to the urine tanks and dung-pits, with regulating valve for both, so that the urine may either be sent into the tanks or pits, as found necessary,	149 10	17 0	8 6	7 0
17.	Box-feeding byre, with turnip and oil-cake stores,	88 0	28 6	10 0	9 8
18.	Calf or bull house, ...	12 0	11 0	8 6	5 3
19.	Tool-house, intended for spades, picks, &c.,	12 0	11 0	8 6	5 3
20.	Gig-house, ...	12 0	16 0	8 6	6 8
21.	South cattle-shed, ...	39 0	16 0	8 6	6 8
22.	Boiling-house. The boiling-house is about the centre of the farm offices, a convenient distance from the stable, potato, and turnip houses, and close to the pump-well and water-trough, .	16 0	16 0	8 6	6 8
23.	Henhouse. The henhouse is conveniently situated for barn-yard by means of an opening in the back-door of cart-shed, and also with farm-house barns and boiling-house. The necessary points to be observed in the construction of poultry-houses are, that they should be kept clean and warm. This latter point is provided for in the present case, the henhouse being attached to the boiling-house, ...	16 0	8 6	8 6	6 8
24.	Infirmary. The infirmary, when not required, can be applied to many useful purposes, and should be attached to every well-constructed set of farm offices, ...	16 0	9 6	8 6	6 8

II. Specifications.

The following specifications show the kind and quality of the materials used in farm-buildings, and how such materials are to be applied in the execution of the work. The most common materials used in Scotland for walls are free and whin stone; the latter is used only when the former cannot be procured but at an additional cost. The other materials most approved of are described in the specification.

The style of farm-buildings should be plain, and the Designer's principal object should be, to make the money allowed go as far as possible in securing comfort and convenience in the arrangement of the buildings. The defects in the arrangement and stability of farm-buildings are, however, not in most cases the fault

of the architect: he is under instructions what buildings are required, how they are to be executed, and what money is to be provided; and as regards extensions or alterations on old farm-buildings, it certainly is a great mistake of the proprietor not to get an outline of a complete set of farm-buildings suitable for the farm, so that any extensions or alterations should be set down in unformity with some fixed principle of arrangement, with a view of not only supplying the present defects, but at after periods, as may be required, completing the original design: by this means, the proprietor is relieved of considerable unnecessary expense.

Drainage.—After the site of the buildings has been marked off, and the surface mould removed therefrom, the next point to be considered is a complete subsoil and surface drainage done with tiles and collars, in the direction most suitable for carrying off the surface-water from the roans and channels round the buildings.

Excavations.—The tracks for the foundations of walls to be dug out to a depth of not less than 20 inches below the original surface of the ground adjoining; and if at that depth a firm and sure substance to found upon is not obtained, the digging to be continued to whatever depth shall be found necessary for that purpose; but in all cases where the tracks are not upon the same uniform level, and one part of them is deeper than another, each separate part or parts shall be a dead level of itself, so that no inclined plain shall be found in the whole range of the foundations.

The excavations for the different floors shall be made so that they may range 3 inches above the centre of clean court, 24 inches above the centres, and 3 inches above the sides of cattle courts, and 9 inches above the adjoining surface outside of buildings, exclusive of the thickness required for pavement, causeway, metalling, and composition. The floors for box-feeding byre to be dug out to the same level as the centre of cattle courts, and the urine tanks and dung-pits to the depth shown on the section E F.

All the soil and subsoil arising from the above excavations to be removed and laid down as shall be directed by the architect, the distance not to exceed 50 yards from the site of the buildings in any direction.

Mason Work—Ruble Building.—The walls to be founded with large flat bedded stones, of the several forms and dimensions delineated on the drawings, and to be at least 8 inches thicker than the wall immediately above, so that a scarcement of 4 inches may be formed on each side. The walls to consist of good ruble-stones and lime mortar in proper proportion; the stones laid on their natural and broadest beds, with band-stones laid through the walls at short distances.

The division walls between byres to be carried up to the height of side walls only, and all the other division walls to be carried up to the ridge. The walls of corn-barn, straw-barn, boiling-house, and riding-stables, to be beamfilled to the sarking.

The walls enclosing cattle courts to be 20 and 13 inches thick at bottom and top, and 5 feet high above the surface, exclusive of a 10-inch high semicircular hammer-dressed cope.

The feeding-cribs in box-feeding byre to rest on a 2-feet thick ruble-stone and lime mortar wall, raised up to the height shown on the section.

The walls on each side of dung-pits to be 14 inches thick at top, and increased in thickness downward 2 inches for every foot in height, and finished on the top with a flat hammer-dressed cope 18 inches broad by 6 inches thick, projecting 2 inches over the wall on each side.

Brick Work.—The engine stalk, to the height of side walls of corn-barn loft, to be carried up with stones and lime mortar, and above that to the height of 35 feet, exclusive of hewn ashlar projections, to be built with circular bricks in the order of a Corinthian column. The necessary flues, and 10 feet up the inside of engine stalk, to be lined with fire-clay bricks. The division wall between boiler and engine-house to be built with bricks on bed. The engine tank to be 6 feet diameter inside, by 15 feet deep, below the surface, built with circular bricks on bed, and arched over on the top, reserving a 20-inch square hatch in the centre, closed up with a 4½-inch thick pavement, with iron ring in the centre. Where the tank is supplied only from surface-water, the outside of walls to be puddled 4 inches thick to prevent leakage.

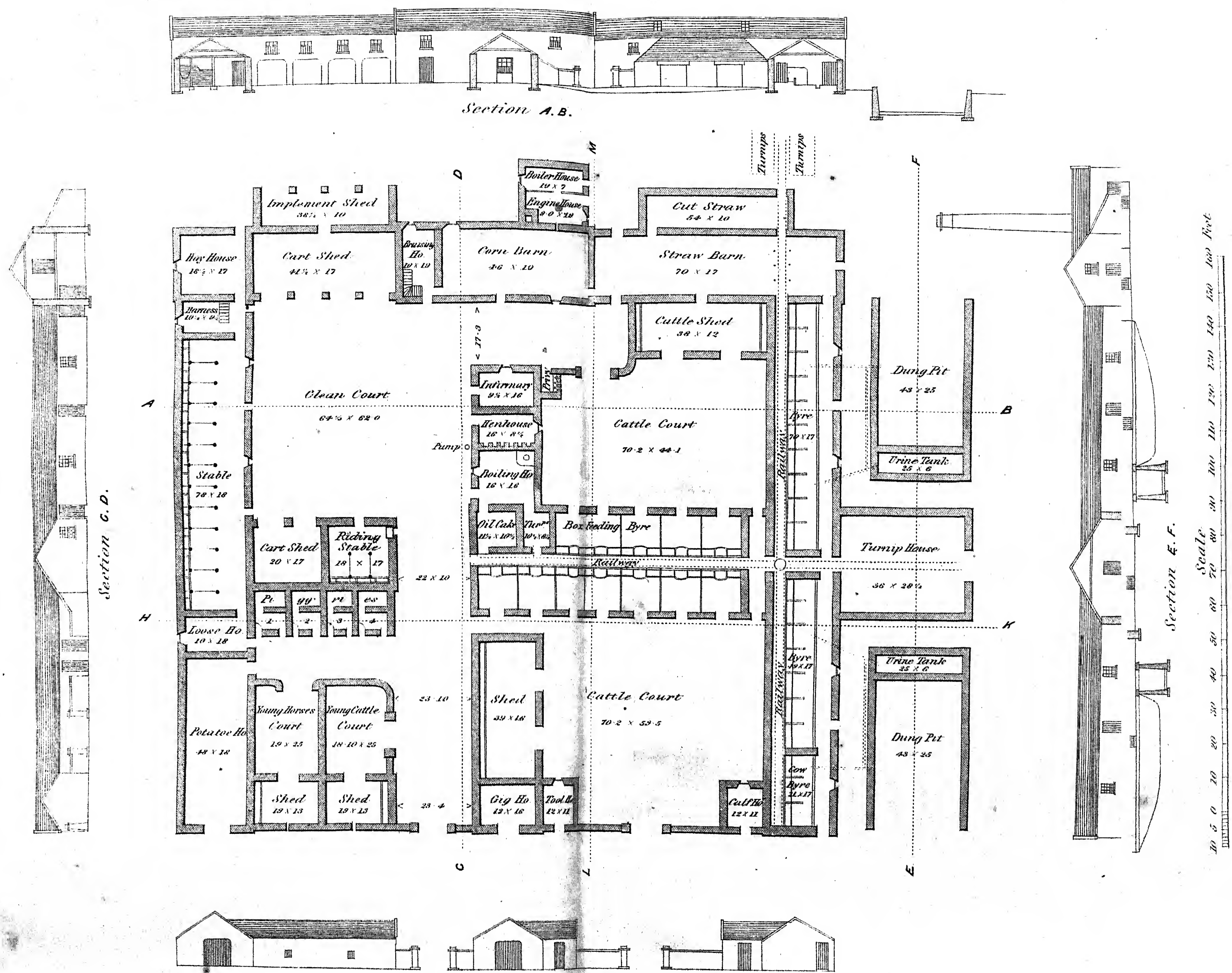
The urine tanks to be built with bricks in length, and arched over in the centre, reserving also a hatch 20 inches square, and shut with pavement. This tank to be furnished with Roman cement inside, and puddled on the bottom and outside of walls, to prevent the urine mixing with mineral water.

Hewn Masonry.—The rybets, sills, and lintels, and arches of doors, windows, and other voids, to have droved margin and ingoings 5 inches broad each, and broached on the tails; the sills of windows to be made to project 2 inches over the walls.

The gig-house, potato-house, turnip-house, and box-feeding byre, side-door to corn-barn loft, and shed boles, to be finished with jiblet checks.

The gate pillars, pillars and arches of cart-shed, scuntions of cattle-sheds, chimney-heads, and all external corners, to be droved 4 inches, girt on the angles, and broached on the faces. The angles of pillars, scuntions and doors, rybets, to be chamfered; the site of the engine to consist of two large stones 3 feet square each, by 10 inches thick, and to be laid and finished as directed by the engineer.

The base and top projections of engine stalk to be droved;



PLAN OF FARM BUILDINGS, BY ROBERT BELL, ESQR ARCHITECT, EDINBURGH.

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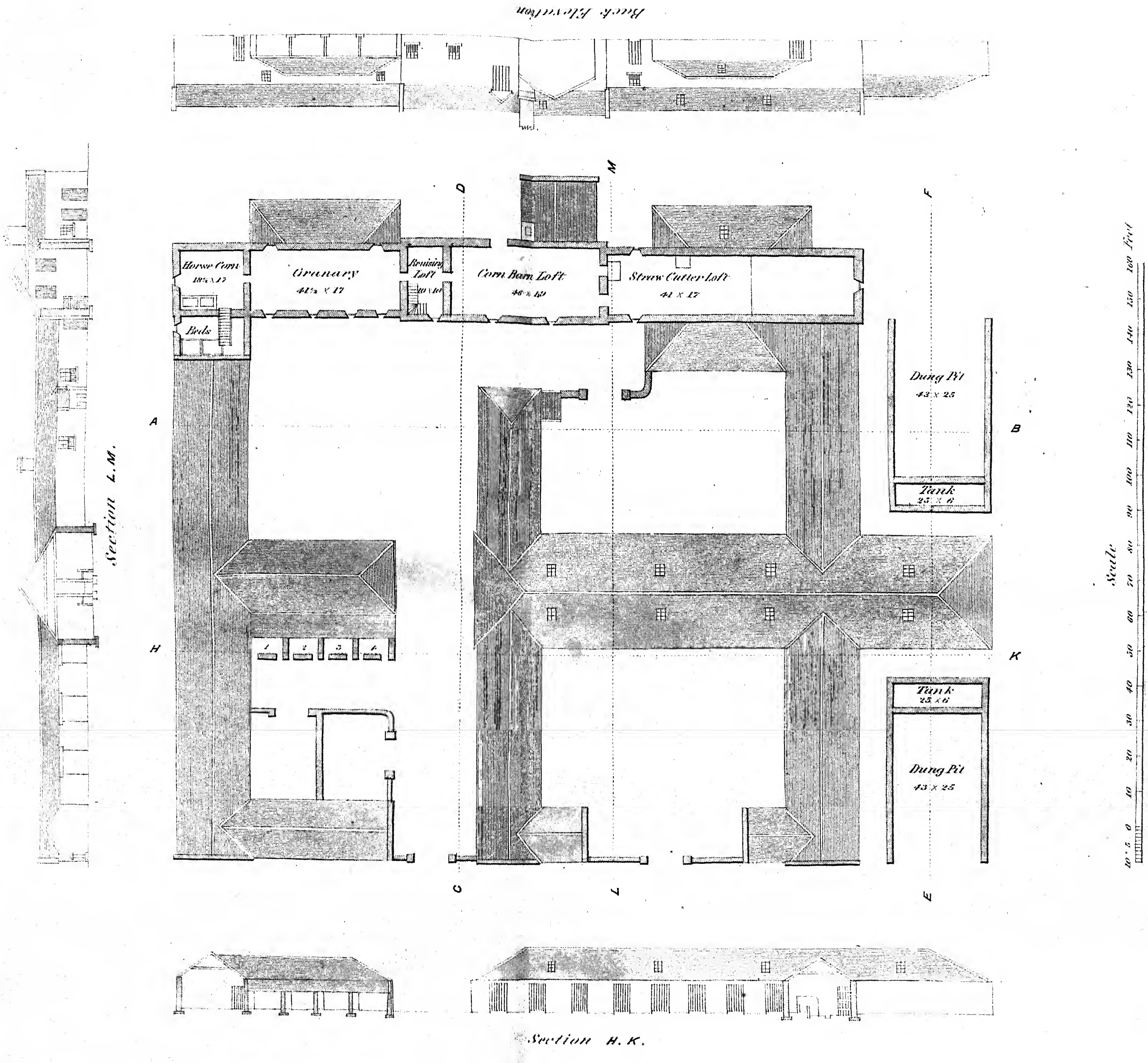

PLATE IV

the block on the top to be hooped six inches broad, with 36 oz. zinc.

The skews to be 15 inches broad, and 3½ inches thick, neatly droved; 2½ inches of this breadth to be made to project over the walls.

The division stones in stall-byres to be 5 feet square, and 4½ inches thick, droved Arbroath pavement rounded on the angles, firmly dwanged with the feeding-cribs, the sides and soles of which in this byre shall be constructed with droved Arbroath pavement 4½ inches thick, 13 and 16 inches broad bottom and top, by 10 inches deep inside.

The cast-metal pillars in implement-house to rest on 16-inch square stone blocks, set down flat with the surface.

The urine channels in stall-byres to have droved cribs and soles, each 5 inches thick; the crib next the cattle to be 8 inches, and that on the other side 4 inches deep, and placed 14 inches apart; the sole of crib to have pervated cast-metal grating every 14 feet in length, and laid to suit the purpose of cover for a box-built drain below, 10 by 8 inches inside. The urine from these channels to be carried off into the tanks and dung-pits through a glazed pipe-tile, 4½ inches diameter, with regular valve for shutting or opening the flow of urine into the tanks or dung-pits, as may be required.

The troughs for piggeries to be droved freestone, hollowed out, 15 by 12 inches, and 10 inches deep.

The channel in riding-stable to be droved freestone, 18 inches broad, and hollowed out in the centre.

The stone blocks for travis posts in stables to be 18 inches deep by 15 inches square; 15 inches of this depth to be set down below the causeway, and the remaining 3 inches above, to be hollowed out in the centre for receiving the posts, and the angle to be chamfered off to meet the causeway.

The cooler for boiling-house to be 7 feet long, 4 feet broad, and 20 inches deep inside, constructed with droved Arbroath pavement 3 inches thick.

The henhouse to have two rows of nests, constructed with 2½-inch droved Arbroath pavement; the one row to be 4 inches, and the other row to be 4 feet above the floor—the sole of upper row to project 5 inches over the walls.

Pavement.—The floors of corn-barn, engine-house, boiling-house, henhouse, bruising-house, to be laid with droved 2½-inch thick Arbroath or Caithness pavement, closely jointed, and laid solid on a bed of engine ashes or lime [illegible]ngs; these floors to be finished with droved pavement skirtin[illegible] inches deep, and 1½ inch thick, 1½ inch of this depth to be [illegible] down between the flooring and the wall, and the remaining 6 inches above the floor to be chamfered off to meet the plaster. Seventeen by ten feet of the floor of straw-barn in front of straw-rack, 12 feet square in front of door to corn-barn loft in stack-yard, to be laid with rough closely-

jointed 2-inch thick Caithness pavement, on a bed of lime riddlings or engine ashes.

Causeway.—The floors of byres, railway passage, dung-pits, passage between dung-pits and byres, tool-house, piggeries, stables, loose-house, infirmary, and 3-feet channels round clean court and passages, to be laid with good ruble whinstone causeway—the stones not to be less than 7 inches deep, and not more than 12 square inches on the top, and bedded in good sharp sand.

Composition.—The floors of straw-barn, cut-straw shed, and potato-house, to be laid with a composition of engine ashes, lime riddling, and ox blood made into mortar, and laid on 3 inches thick, and closely rubbed down till dry.

Metalling.—The clean court, and passage, within channels, 20 feet broad in front of offices, and road leading to stack-yard, to be laid with small broken whinstones 6 inches thick.

A box-built drain, 8 by 6 inches inside, connected with the urine tanks, to be laid along the centre passage of the box-feeding byre; this drain to be 3 inches diameter, and to communicate by a pipe and grating with each box, for carrying away any unnecessary damp below the cattle.

Joiner-work—Safe-Lintels.—The safe-lintel over doors, windows, and other voids, to be of sufficient breadth, and 1 inch thick for every foot of opening they cover, with a wall-hold of 9 inches at each end.

Beams.—The granary to have beams 12 × 6 inches resting on the front pillars and back wall, with 12 inches of wall-hold at each end.

The drum-shakers to be supported on two beams 12 × 6 inches, and one beam, 16 × 8 inches, fitted up and finished under the direction of the mill-wright. The beams for cattle and implement-sheds to be 6 × 18 inches, cleaned off on the out face, and beaded on the under angle, with 10 inches of wall-hold at each end.

Roofing.—The roofing to have scantling $6\frac{1}{2}$ × by $5\frac{1}{2}$ inches broad bottom and top, by $2\frac{1}{4}$ inches thick, and placed 20 inches between centres, with baulks $5\frac{1}{2}$ × 2 inches, placed $\frac{3}{8}$ below the top, and wall-plates $8\frac{1}{2}$ × $1\frac{1}{4}$ inches.

The sarking to be $\frac{3}{4}$-inch thick, closely nailed together; that over the granary and bruising-house to be half checked.

The ridge and peind battens to be $1\frac{1}{2}$ inch diameter, firmly fixed with strong iron studs.

Ventilators.—Ventilators to be made in the roofs of stables, byres, calf-house, boiling-house, loose-house, infirmary, and boiler-house, with galvanised sheet-iron, or boards clad over with zinc, similar to those used for railway sheds, with this difference—a bead to be made on the top, in imitation of the other part of the ridge.

Joisting.—The joisting for corn-barn, straw-barn, and hay-house lofts, to be $10\frac{1}{2}$ × 2 inches, placed 20 inches between centres, with 9 inches of wall-hold at each end, and one row of dwanges along the centre, 6 × 2 inches.

The joisting for granary, bruising-house, and stable-beds, to be 7 × 2½ inches, and placed 20 inches between centres, with 9 inches of wall-hold at each end.

Flooring.—The flooring for lofts of barns, granary, horse corn-loft, stable beds, to be 1¼ inch thick, grooved and tongued; that for stable loft to be 1½ inch thick, resting on the runbeams at each end. The skirting for deal flooring to be 3 × 2 inches, nailed on the flooring, and chamfered off on the top angle to meet the plaster.

Doors, Boles, &c.—The door and bole-boards for sheds to be plain deal, 1¼ inch thick, grooved and tongued, the deals not to exceed three inches broad, and beaded on the edges of the joints with three back bars on each door, and two on each bole-boards 6 × 1¼ inch. The doors on gig-house, potato-house, turnip-house, corn-barn loft, and four doors on stables, to be hung in two halves; the doors on loose-house, infirmary, and calf-houses, to be also in two halves, cut across the centre; the piggery door to have vertical sliding frames, to lift out if required. The division-wall doors to have standards 4½ × 2 inches, and keps 3 × ⅝ inch, firmly fixed with dooks built into the wall.

Windows.—The windows on ground floor to be fitted up two-thirds, and those in upper floor one-third below the top with second crown glass; the other portions to be fitted up with vertical storm boards.

The different skylights to be glazed with second crown-glass in cast-iron frames; and that above rollers in corn-barn loft to open on hinges on a raised frame; the soles of windows to be clad with ¾-inch plain deals.

Hatch-Boards.—The hatch-boards in straw-barn loft floor, and granary floor, the former to be 5 × 2½ feet, and the latter 40 inches square, each to have two back bars 6½ × 1¼ inch.

Stairs.—The stairs in bruising-house and harness-room to be constructed with steps and standards of sufficient strength.

Stable Travises.—The stable to have tie-beams 6½ × 2½ inches directly above each travis-board, firmly nailed to the bottom of the scantling at each end. The runbeam 6½ × 2 inches, to run parallel with the side-walls of stable, and to be nailed down on the top of the head and heel posts, and also checked into the tie-beams above. The head and heel posts to be 6½ inches square each, rounded on the angles. The travis-boards to be 1½ inch thick, iron-douled on the joints.

The travis-boards to be firmly fixed into the posts in the usual way, with sole and coping of oak 3½ inches square each, grooved half-inch deep, for receiving the boards, rounded on the angles, and firmly fixed into the posts at each end.

The hay-racks to be 2⅝ inches broad over the rails, and to be securely fixed up to a height and slope, as shall be determined by the architect.

The mangers in large stables to be 2¼ feet long, 15 and 10

inches broad top and bottom inside; the remaining space of stall to be fitted up with grass-racks the height of manger, and finished with an oak rail 6 × 4 inches along the front of mangers, and under racks, and rounded on the angles.

The riding-stable to be fitted up in the same manner, except that there are to be no grass-racks, and the mangers are to be 6 feet long, 14 and 9 inches broad top and bottom, with oak rail 6 × 4 inches along the front of manger, and rounded on the angles. Each stable to have sufficient brackets and harness-pins built into the walls.

The corn-chests in horse corn-loft to be each 3 × 2 feet at bottom, and 5 × 3 feet at top, by 4 feet deep inside; those chests to have each a wooden pipe conductor, 4 × 2 inches, leading through the wall into the harness-room. The under end of this pipe to have two sliders, fixed at such a distance apart as that the vacuum formed shall be equal to the size of a common feeding measure: the principle of the construction of this apparatus will be provided by the architect.

The corn-chest in riding-stable to be fixed and fitted up in the bossing of the window, sufficient to hold one boll of oats.

Box-feeding Byre Partitioning.—The feeding cribs or box-feeding byre to be cast-metal, 3¾ feet long each, 16 and 20 inches broad bottom and top, by 10 inches deep each. The space left in the centre between boxes to be fitted up with straw racks 3½ × 2 feet, and 3 feet high above the soles of feeding cribs, and sparred all round. The partitions in box-feeding byre to have two posts 5 inches square for each single division, the one placed in the ruble wall by the side of centre railway passage, and the other betwixt that and side wall, both carried up within two inches of the height of side walls, and fixed on the top with 7 × 2½ inch tie-beams, and 5 × 2 inch runbeams, in the same manner as those specified for stable. Each partition to have four rails 5 × 2 inches placed 12 inches apart, firmly fixed into the above posts at each end. All the byres to have an iron rail, 1¼ inch diameter, fixed 20 inches above, and directly over the outer edge of feeding cribs, with swing-boards attached, 1¼ inch thick, hung from the top; so that, by pressing the board back below, the cribs may be cleaned out, and filled with turnips, without disturbing the cattle. The same principle of boards to be applied to the piggery troughs. The iron bars in box-feeding byre to pass through centre of a 5-inch square upright post in the centre, and also at each division.

Railway Sleepers.—The sleepers for railway to be 4½ × 2½ inches, placed 3 feet apart, and laid on a solid substance.

The five gates required for courts to be hung from 8½ inch square wooden posts, placed flush with the outside of pillars, so that they may open outwards conveniently. These posts to be built 20 inches into the ground with stones and lime mortar, and to stand 6 feet above the surface. Each gate to have 6 × 4

inches hanging stiles, $5\frac{1}{2} \times 3\frac{3}{4}$ inches centre stiles, and $5 \times 3\frac{1}{2}$ inches front stiles, with rails each, 5 and $4\frac{1}{2}$ inches broad, by $1\frac{3}{8}$ inch thick. Each rail to pass through the centre stile, and to be mortised into the other two stiles at each end. The two under rails to have vertical dwarf spars $2\frac{1}{4} \times 1$ inch, 18 inches high, and placed $2\frac{1}{2}$ inches apart. The small gate in passage to south cattle-court to be the size and description of half one of the large gates.

All the wood used, except the oak already specified in stable, to be of the best Memel timber; the deal flooring may be of Dram battens; but all the timber of every description to be of the best quality, free of sapwood, loose and large knots, and other blemishes.

Iron Work.—The cast-iron feeding cribs for box-feeding byre to be the size given in the joiner work, cast $\frac{7}{8}$ inch thick, with $2\frac{1}{2}$ inches broad flanges round the top. The rails to be 2×1 inch malleable iron, fixed on the sleepers with spike nails. The pillars for implement-shed to be cast-metal, $4\frac{1}{2}$ inches diameter, with plate at top 12×1 inches, with sockets for pillars, and holes for nailing the plate to the beams.

All the outside doors to have strong crooks and bands, the crooks to be eight inches long, with split tails, and firmly fixed into the rybets. The division-wall doors to be hung from strong T hinges. Twenty-six doors to have strong stock-locks, and fourteen of that number to have folding-keys and sunk ring-latches; all the other doors and boards to be secured with strong iron back-bars. The gates to be secured with iron hasp, chain, and pin, and gates and hatch-boards to be hung from strong crooks and bands. The swinging-boards above byre-feeding cribs to be hung from $1\frac{1}{4}$ inch diameter iron rod; in the one byre the rod is to pass through the 5-inch square posts, and in the other byre it is to pass through the division stones 20 inches above the feeding-cribs. The cattle in stall-byre to be secured with run-rods and chains fixed to the division-stones. Each stall in stable to have two rings and staples for securing the horses.

The corn-chests and hatch-board in granary to be secured with strong padlocks; all the iron work to be of Scotch manufacture.

Lather's Work.—The ceilings of boiling-house, riding-stable, engine-house, and stable bed-lofts, to be lathed with good split lath.

Plasterer's Work.—The ceiling and walls of boiling-house, riding-stable, engine-house, and walls of corn-barn and loft, bruising-house and loft, granary, horse corn-loft, men's bed-loft, stables, and harness-room, to get two coats of good hair-lime plaster.

Plumber's Work.—The ridges and peinds to be covered with 5-lb. lead, the flanks and flashings round the skylight and gutters with 6-lb. lead. The pump at boiling-house door to be cast-metal, with lead pipe $1\frac{1}{4}$ inch attached to the boiler and feeding cribs in byres, with soil-pipe from the feeding-cribs to the nearest drain.

The roofs to have 20 oz. zinc roans and iron upright conducting pipes, with sufficient iron straps.

Painter's Work.—All the external doors, windows, and wood-work of every description, to get three coats of the best oil-paint.

III. Cost of Buildings.

The cost of the buildings above described has been estimated at £1690, with the understanding that the proprietor furnishes to the contractor the free use of a quarry on the estate, and that the materials are laid down on the ground free of carriage, which is in some instances performed by the tenant.

SUMMARY of the DISCUSSIONS at the MONTHLY MEETING of the HIGHLAND and AGRICULTURAL SOCIETY, during the Winter of 1850-51, being the ADDRESS delivered at the concluding MEETING of the SEASON.

By Thomas Anderson, M.D., F.R.S.E., Chemist to the Society.

The following address was delivered, with the hope of attracting general attention to the important and valuable discussions of the season, which appeared to the author of much general interest, and deserving of a more permanent record than they have hitherto obtained. The necessity of bringing it within the limits of an ordinary meeting compelled him to pass over some parts of the discussions in a more cursory manner than could have been desired, but he has endeavoured to give as full details as the circumstances would permit, and he believes that none of the more important points have been omitted. With the exception of a few unimportant verbal alterations, it is printed exactly as it was delivered.

Those who have attended to the recent progress of the Highland and Agricultural Society cannot fail to have observed that the monthly meetings have for some years past been gradually increasing in interest and value, and, from a comparatively subordinate part of the business, have come to be a really important means of encouraging the progress of agricultural knowledge. The meetings of the past season have, in this respect, been peculiarly interesting, not merely on account of the importance of the subjects discussed, but still more from the presence at each of some of the most distinguished and skilful agriculturists connected with different parts of the country, who have communicated to the Society the results of the experience of their districts; so that the opinions expressed, and practices supported, may be considered to represent the most recent and improved information of the whole of Scotland, and are useful now as indicating the newest and most approved practice, and may become at some future period most interesting points of

comparison, for estimating the rapidity and extent of the future progress of agriculture. It is with the intention of once more calling attention of the Society to the important results which have been elicited, that I have undertaken to give a short resumé of the discussion at each of our meetings, and to point out, as far as is compatible with the limits usually allotted to our meetings, those points which appear to be most worthy of observation, or deserving of further inquiry or experiment. I have no intention to criticise, but I cannot avoid expressing my estimation of the value of the facts brought out, the precision and clearness with which the statements of our different speakers have been expressed; the constant reference to the scientific principles of agriculture, and the results of accurate experiments, which I look upon as the most unequivocal evidence that our farmers are imbued with the true spirit of progress; and the evident care and trouble which they have devoted to the papers read, which show that our practical men possess the power of literary composition to a much greater extent than they are themselves generally inclined to admit.

The subjects of our discussions during the past winter have been four in number.

1st, The best varieties of wheat to sow; the quantities of each, and comparative advantages of drilling, dibbling, and sowing broadcast.

2d, The substances which can be most profitably employed as auxiliary for turnips, for fattening cattle and sheep.

3d, The best mode of preparing and applying the different manures produced upon the farm.

4th, The most suitable proportions and quantities of grass and clover seeds to sow for hay, soiling, and pasturage; the substances most profitable for top-dressing, and the proper time for applying them.

The subject of the first discussion—that of the best varieties of wheat to sow—is one of a purely practical character, on which I shall not venture to offer any opinion, but shall endeavour, as succinctly as I can, to review the opinions of the different speakers. The subject is unquestionably one of great and increasing importance to the farmers of Scotland, as it appears from Mr Finnie's statement that, within the last ten years, the cultivation of wheat has extended so greatly in Scotland that the breadth of land under that crop now exceeds that under barley, while, previously to that period, exactly the reverse was the case.

The subject naturally divides itself into several sections, of which the first relates to the variety of wheat to sow, and on this point a very remarkable agreement exists among all the different speakers. It appears, as indeed we might *à priori* expect, that close attention must be paid to the climate and soil of each farm, and that certain wheats are adapted to the climate of different

districts. It is distinctly made out by the concurrent testimony of the speakers, that few, if any, of the English varieties of wheat are adapted for cultivation in Scotland. Many have been tried, among which Taunton Dean, Tall Cluster, Kent White, Woolly-eared, Uxbridge, Talavera, and several others are enumerated; but experience has almost invariably proved unfavourable, the quantity having generally been decidedly inferior to that obtained from Scotch wheats, and the quality, though at first occasionally fine, appears soon to have undergone degeneration. The only exceptions to this general statement are in the observations of Mr Scott and Mr Rannie, the former of whom had found Talavera most valuable as a spring wheat in the Mid-Lothian district, and the latter speaks of Uxbridge as having been profitably cultivated in the Carse of Gowrie. However this may be, there can be no doubt that the introduction of English wheats has generally proved a disappointment; and, though this should not deter farmers from the trial of every new variety, it ought to enforce caution, and to indicate the necessity of making the experiments on a small scale, and repeating them through several years, in order to ascertain that there is no deterioration of the grain, and that no special peculiarities of season affect the results of any one year.

Of the ordinary Scotch wheats, the varieties *largely* cultivated do not exceed four or five, and these have attained the support of the farmers of all the principal wheat districts of Scotland. The varieties are Fenton, Hopetoun, Hunter's, Red straw white, Spalding's prolific, and one or two others of inferior importance. Of these, the first appears to be most generally preferred, and it possesses the important advantage of having a short, thick, and strong straw, which makes it little liable to lodge, and peculiarly adapted to high farming. The Hopetoun and Hunter's, next to it, are the most approved, and, until lately, Hunter's appears indeed to have been the most generally cultivated of all the Scotch varieties. The origin of those different varieties of wheat, which was particularly referred to by Mr Hope, is exceedingly interesting, and is suggestive of the importance of endeavouring to introduce new and still more improved varieties, for each new variety which has been hitherto introduced appears to be preferable to the previous, and there is no reason to suppose that we have yet reached the best or most productive variety. Each of the three important varieties to which I have already referred spring originally from a single plant, from which all now cultivated have been produced. Hunter's, which for nearly half a century has been the most extensively cultivated, was raised from a plant found by Mr Hunter by the roadside in Coldingham Moor; Fenton was propagated by the late Mr Hope, Fenton Barns, from three ears found growing in an old quarry; and Hopetoun from a plant found near Drem, in East-Lothian.

Now, it appears that these plants were originally selected for their fine and healthy appearance, and from their possessing those characters which seemed suitable for cultivation; and as experience, extending, in the case of Hunter's, over nearly half a century, shows that their characters are extremely permanent, there can be little doubt, if the attention of practical men were more largely directed to the point, that, by the selection of fine and healthy ears, still finer varieties might be produced. It is no doubt somewhat difficult to determine *à priori* how we ought to set about it—but still it appears to me that some method might be devised by which a grain of superior quality may be produced. Suppose, for example, we were to take the best of our present wheats—Fenton, for instance—and to select from a field, or from a small patch specially cultivated for the purpose, the best and finest ears, just when they have come to a state of perfect ripeness, and select again from these ears the finest and largest grains, I conceive that we should in all probability raise from such a sample a crop of wheat superior to the average of the original variety. If again this selection were followed up on that produce, I can conceive a still farther improvement. Such a course of experiment is well worthy of being followed out; and we have abundant evidence that, when a fine variety is once established, it may be propagated for many years without undergoing deterioration: at least such has been the case with Hunter's, which, after half a century, is still one of the best varieties.

As to the quantity of seed sown, considerable difference appears to exist in the different districts. In East Lothian, from 8 to 9 pecks are given up to 20th November, after that ten, in December 11, and in spring 12 pecks. Nearly the same proportions are recommended by Mr Scott and Mr Dickson as those they have found best adapted for their purposes; but Mr Finnie employs from 12 to 16 pecks, and in Stirlingshire from 8 to 15 appear to be used, and after green crop 2 or 3 pecks more. In one point all the speakers agree, and it is the necessity for increasing the quantity of seed as the season advances—a practice which appears to me to be explicable on physiological grounds. The probability is, that all the grains of wheat are not equally readily germinated, some requiring a longer time to commence their growth, and when they are later sown, less time being allowed them for this purpose, a large number never come to maturity; and, to provide for this, an increased quantity of the grain must be sown. The habitual employment by some farmers of a larger quantity of seed than is customary with others is probably dependent upon similar causes. Mr Finnie, for instance, employs a very large quantity. Now, his farm is high-lying and exposed, and on it the germination of the wheat is more likely to be slow and imperfect than on those farms

which have a superior climate. Should this explanation be correct, it may serve to indicate to those cultivating in high and backward districts the necessity of giving a liberal supply of seed. And it may also explain the different experience of Scotch and English farmers on the subject of thin-sowing, a practice which has been tolerably successful in England, but in Scotland has invariably been attended with disappointment. The superior climate of the wheat districts of England enables nearly all the grains to germinate; while here, unless in favourable seasons, this cannot be expected.

On the subject of the different methods of sowing, the experience of the speakers appears to vary more than on any other point; and on one method—that of dibbling—we have very little information; the only experiments referred to being those of Mr Hay of Whiterigg, who found that a larger produce of wheat was obtained from dibbled wheat than from that sown broadcast, but that the quality was decidedly inferior—the former containing a larger proportion of light grain, and the good weighing only 59 lb., while the broadcast weighed 62 lb. Opinions seem to be pretty equally divided between broadcast and drilling; and Mr Paterson and Mr Hope state that no difference is to be observed between these two methods of sowing. That this should be the case, in some instances, I can easily imagine; but I should, for my own part, and on theoretical grounds, be inclined to support the practice of drilling, and my reason for doing so is the facility which it affords of employing the hoe—a practice which is consistent with theory, and which I believe has been found advantageous on most farms. As far as the *mere sowing* goes, however, I cannot see what advantages the one can possess over the other. Provided the grain be pretty equally distributed and properly covered, I should imagine it immaterial whether it be arranged in straight lines or dotted over the land. It is the facility of cleaning the land which gives drilling its superiority.

Mr Hope has touched, in his observations, on the prevalent idea that wheat is a more exhausting crop than any of the other cereals—as oats, for instance—and has expressed the opinion, in which I agree with him, that this can scarcely be considered to be correct. Weight for weight, no doubt wheat is so; but, in order to arrive at a fair result, we must not compare equal weight, but determine the total amount of valuable matters removed by a crop of each, and we shall then find that an oat crop ought to be decidedly more exhausting than wheat, as it removes from an acre a much larger quantity of these substances than the latter. The grain of wheat and oats contain very nearly the same per-centage of nitrogen, but the amount of mineral matters is twice as great in the latter as in the former;

and if we further take into account that a wheat crop may be from 4 to 5 qrs., and an oat crop from 8 to 10 qrs., it seems tolerably clear that the exhausting effect of the latter must be decidedly greater than that of the former. I confess, however, that I do not think we ought to discuss too minutely the comparative exhausting effects of different crops, a question which really appears to me a less important consideration at the present time than it was in a less advanced state of the science and practice of agriculture. It was of paramount importance under the old system of agriculture, when we trusted much more to the unassisted efforts of nature than it would be considered either prudent or profitable to do at the present day. The system of high farming now prevalent, however, is characterised by the continual addition to the land of a much larger quantity of those matters than the crops remove from it, so that when that system is fully and effectually carried out, no deterioration, but rather an improvement, of the land takes place.

The second discussion—on the substances which can be most profitably employed as auxiliary to turnips in the fattening of cattle and sheep—presents another of these subjects which the progress of agriculture has raised to a high degree of prominence and importance. Mr Brodie of Abbey Mains, who opened the discussion, has illustrated this by a number of very interesting details. He informs us that some farmers employ extra keep for their stock to the extent of £1 per acre over the whole of their holdings, and that, taking the country at large, many millions sterling are annually expended on the purchase of such food. Considering the magnitude of these sums, one would be inclined to anticipate that every farmer would have endeavoured, by careful experiment, to determine the plan of feeding best adapted to his farm. Mr Brodie, however, is inclined to think that this is not generally the case, and that, notwithstanding the extent to which the use of the extra food has reached, many farmers have adopted their special systems without that amount of careful experiment and minute registration of expenses which are required for a full estimate of the advantages and profits of their practice. I do not pretend to know how far this may be generally correct; but I can easily understand that there are many instances in which special circumstances may have induced a person to adopt a particular practice, and carry it on for a long period with average success, without a sufficiently complete comparison with other systems to enable him to determine whether it is really the most profitable that can be employed.

The employment of other substances along with the turnip is a practice in all respects consistent with our knowledge of the physiology of digestion. When an animal exists in its ordinary state, it consumes the quantity of food requisite for sustaining its health,

and no more, and its stomach and other organs are only constructed to permit the consumption of the amount of what may be called the natural food required for its healthy existence. The object of the feeder, however, is to cause his cattle to consume a larger quantity than this, so as to produce what may be called an unnatural accumulation of flesh and fat. But the increased amount which can be consumed is limited in the case of the turnip, by its excessive bulk, which overloads the stomach and prevents the process of digestion going on with that regularity and completeness which is required. In order that digestion may be complete, every part of the food must, by what are called the peristaltic motions, be brought into contact with the absorbing surface of the intestines; but when the quantity of food is excessive this takes place imperfectly, and the intestines are distended in such a way as to retard the process of absorption. The feeder must therefore endeavour to supply a large quantity of nutriment in a smaller bulk, and for that purpose he is compelled to select some auxiliary to his turnips, by which he gains not merely in the improvement of his stock, but also in the production of a larger quantity of valuable manure. In the selection of the particular auxiliary to be employed, then, the farmer must look for that which contains the largest amount of nutritive matters at the smallest price; and in doing this, we require to consider two points: firstly, the chemical composition of the substances, by which we determine the amount of nutritious matters contained in them; and, secondly, the proportion of these matters which may become available to the nutrition of the animal. The first of these is a matter on which, by extended chemical analysis, much light may be thrown, but the latter is a question for experiment on cattle themselves. It is not a chemical, but a physiological question, and its importance will be understood when we bear in mind that, even where *digestion is complete*, a certain proportion of the valuable matters always escapes assimilation, and that the proportion which does so may vary in different species of domestic animals, and even in the same animal at different periods of its life. To take an illustration of this point, suppose we supply a lot of sheep and a lot of cattle with the same quantities of food, it by no means follows that the increase in weight of the two shall be equally great; in other words, the same quantity of food supplied in the two cases does not produce the same amount of fat and flesh: yet, in both cases, the amount of nutritive matters is the same, and the cause of the difference is in the physiological peculiarities of the different species of animals. Now, chemistry can supply the requisite information as to the amount of nutriment which any food contains, but it obviously cannot be expected to foretell the *proportion* of those *nutritive* matters which the digestive organs of the animal will convert into flesh and fat: that must be done by experiment upon

the animals themselves. The investigations of different chemists have thrown much light on the nutritive value of different foods, and at the discussion I referred to experiments in progress in my laboratory, the object of which was, to form a complete and extended table of the nutritive value of all our most important cattle foods. In those experiments, the proportions of nitrogen and oil, which are infinitely the most important of nutritious elements, have been selected as the means of comparison; and I am engaged in the formation of a table which, when complete, will enable us to estimate the comparative values of the foods employed. Of that table, the following gives a few of the results: it shows the number of pounds of nitrogen and oil contained in the different foods, deduced principally from analysis made in my own laboratory, partly from the results of other chemists:—

	No. of lbs. in a ton of Nitrogen.	Oil.
Linseed, English,	97	777
" Foreign,	76	715
Oil-Cake,	103	224
Poppy-Cake,	110	229
Rape-Cake,	105	223
Beans,	85	32
Peas,	77	29
Oats,	60	—
Barley,	42	—
Oat-Dust,	27	83
Turnips,	4¼	7
Distillery, Dreg or Wash	5½ oz.	—

Now, by comparing these results, it will, I think, be sufficiently clear, that no substance is equal to oil-cake in point of nutritive power, the money value being taken into consideration. A ton of oil-cake may be bought for L.8, and for that sum there are obtained 103 lb. of nitrogen, and 224 lb. of oil. A ton of turnips, on the other hand, is valued at somewhere about 8s.; 20 tons will, therefore, bear the same money value as one ton of oil-cake, but they will afford in the form of nutriment only 85 lb. of nitrogen, and 150 lb. of oil; and by comparing the other substances, it will be seen that poppy and rape cake supply nutriment at a still cheaper rate. All these are what may be called oleaginous foods, but there is another class of substances which are deficient in oil, but rich in nitrogen and starchy or saccharine matters, and which, though inferior to the former class, are still of much value and importance. Beans and pease rank as the most valuable of this class; and after them follow oats, barley, and the other grains.

Such are the conclusions which chemistry teaches us to draw as to the comparative values of the more important varieties of cattle food; and their general correctness was fully confirmed by the very valuable and clearly explained practices of the gentlemen who favoured the society with their opinions. Mr Brodie gave the result of a very interesting and complete set of experiments on

four lots of cattle—the first fed with turnips alone; the second with turnips and oil-cake; the third with turnips and ground corn, and the fourth with distillery grains and bean meal. The cattle were kept from October to June, and at the end of that time the first lot weighed 536 stone, and had cost in feeding, £108, 9s.; the second lot weighed 552 stone, and cost £103, 16s.; the third lot weighed 517 stone, and cost £113, 8s.; and the fourth weighed 545 stone, and cost feeding £118, 3s. Here we have the most conclusive evidence of the superiority of oil-cake, for, be it observed, the cattle fed with it weigh 16 stones more than those fed with turnips alone, while the cost of feeding has been nearly £5 less. Where corn has been used the difference is still more conspicuous, the weight being 35 stones less than the second lot, and the cost of keep nearly £10 more. These results are also fully borne out by the practice of Mr Kennedy of Myremill, and the other speakers at the meeting, all of whom have found the great advantage of giving other foods, and especially oil-cake, as auxiliaries to turnips; and we can understand at once the cause of the successful results of their practice when we inquire, not into the gross weight of the food they give, but the amount of nutritive matter it contains. Thus, for instance, Mr Kennedy considers that the best practice is to allow 60 or 70 lb. of turnips, and in addition to that 2 lb. oil-cake boiled into mucilage, and poured over 2 lb. bean-meal, 2 lb. bruised oats, 12 lb. hay, and a stone of chaff. Now, these substances contain in all about ¾ lb. of nitrogen, which is equal to the quantity of that element contained in above 3 cwt. of turnips. Suppose, however, that the animals were fed on turnips alone, 2 cwt. would be about as much as they could well consume, or they would be able to obtain less than two-thirds the nutriment which they get from the food supplied by Mr Kennedy's plan of feeding. Mr Russell and Mr Wilson have added their valuable experience to that of the other speakers in support of the example of supplying food in much the same manner as is done by Mr Kennedy, and in every case we observe that there is given a quantity of these substances containing much more nutritive matter than is contained in the quantity of turnips which they replace. Now this directs our attention to the question to which I have already alluded, of the availability, if I may so express it, of the nutritive matters in these different foods. It needs scarcely be observed that where, as in Mr Kennedy's case, the supply of nutritive matter is so greatly above what can be consumed in turnips, the weight of cattle is not *proportionally* increased. The cattle become fatter, but not to the extent which might be expected from the largely increased supply of food, because the nutritive matters are not so readily assimilated in the forms in which they exist in oil-cake, and other similar substances, as in turnips.

It is obvious, from all we know, that the nutritive matters of different foods are not all equally easily converted into flesh and fat; but we are entirely without information as to the relative facility of assimilation of these matters in the different foods and forms of combination, and yet there cannot be a subject more deserving of minute inquiry, and more likely to throw light on the scientific principles of feeding. It is especially for the determination of this point that I think careful, minute, and oft-repeated experiments on feeding of stock, with food of known composition and quantities, are requisite. Such experiments, however, would require a far more minute and constant attention than it is possible for a farmer occupied with his other avocations to give them, and, in fact, are of a sort which would require the exertions of a Society supplied with liberal funds. I am free to admit, that, with the present feeling of the agricultural public, their performance on anything like an extended scale is at the present moment almost impossible; but I feel equally certain that the time will come when it will be absolutely necessary that such experiments shall be made. In the mean time, I do not see that we have any reason to complain of the advances hitherto made. The statements of the speakers show how greatly the practice of feeding has extended, and the attention which has been bestowed upon it; and as the time goes on, we may feel sure that the principles of successful practice will become more and more understood; but, could a systematic series of experiments be instituted under the supervision of some of our great agricultural societies, I am convinced that most important results would be derived from them.

The third discussion—on the best methods of preparing and applying the different manures produced upon the farms—brought out a large amount of precise and valuable information, and may be looked upon as a very valuable illustration of the care and attention now devoted by our best farmers to such matters. Mr Finnie, who opened the discussion, entered at great length into the best arrangement of a farm-yard, the manure-heap, and liquid-manure tank, best adapted for the collection and preservation of the shed and liquid manures. His principles, without entering into details, may be described as endeavouring as far as possible to collect the liquid separate from the solid excreta. The latter he would interstratify with peat, where it can be had, or, failing that, with soil or clay, while over the heap he ladles the liquid manure, so as to allow as much as possible to be absorbed, and collects in the liquid-manure tank only that which cannot be retained. Mr Finnie, with full knowledge of the beneficial results obtained from the application of liquid manure, is of the opinion, in which I fully agreed with him at the meeting, that it will, generally speaking, be much more economical to apply manure in the solid than in the liquid state. When liquid manure can be

obtained in any quantity, and applied exactly as it is required, no method, perhaps, produces more striking results. Its invigorating effects are immediately seen, and by them we are apt to be led to estimate its value more highly, perhaps, than it actually deserves, and even to conceive it to be superior to, and likely to form a substitute for, the solid farm-yard manure. I do not, however, think that this is consistent with what we know of its chemical composition, which should incline us to class it rather as an auxiliary, such as guano, sulphate of ammonia, and the like. Viewed in this way, its importance cannot be over-estimated; but I confess I conceive it doubtful whether its advantages are likely to be felt, excepting upon what may be called altogether exceptional farms, where its quantity is so great that it becomes desirable to erect machinery for its economic distribution. That such cases exist, the experience of several distinguished farmers seems unequivocally to show; but nothing would be more rash than to attempt the extension of their systems to the general husbandry of the country. In fact, we must have solid as well as a liquid manure, and for the very important reason that the latter is deficient in phosphates, which are among the most important and needful elements of our cereal crops; and wherever the quantity of liquid manure does not exceed that produced on ordinary farms, I agree with Mr Finnie in thinking that the best and most economical plan is to convert it by means of absorbents into solid form, rather than to attempt the application of it partly in that, and partly in the liquid form. On the subject of these absorbents we have heard a good deal lately, and peat, charcoal, and various other substances have been recommended, more especially for the purpose of retaining the ammonia. Some experiments and analyses made in the Laboratory of the Society on this subject will be found in the last Number of the Transactions, which show that in this respect peat itself greatly surpasses charcoal, or any other substance. In these experiments, it was found that solution of ammonia was absorbed in the most effectual manner by dried peat, and that even when the saturated peat was exposed to the air until it became dry, it retained a very large quantity of ammonia. It was, however, always observed that the moist peat absorbed a larger quantity of ammonia than it was capable of retaining when it became dry, as much as half the ammonia occasionally escaping in the latter case; and this fact I consider peculiarly worthy of observation, as it indicates, what practice confirms, the necessity of keeping the dung-heaps in a state of moderate moisture, which is the condition best adapted for preventing the escape of its ammonia. There cannot, on the other hand, be anything more important than the avoidance of too large a quantity of moisture, nothing being more prejudicial to the manure-heap than its exposure to all the vicissitudes of our climate—at one moment saturated, or more than saturated, with

rain, at another dried up by the heat of the sun—both cases in which a loss of ammonia must be occurring, with much more than the average rapidity.

All the gentlemen who took part in the discussion were fully alive to the importance of this point, and it afforded me much satisfaction to observe that one and all of them supported the introduction of covered manure-depots, which I anticipate will be the next great improvement in the arrangement of our farm-steadings, for it is only under cover that the perfect preservation of manure can be effected, or all those precautions taken which are required to protect it from loss. Such opinions, however, though they are consistent with theory, and are borne out by the observations made on the superior value of the manure produced by the system of box-feeding, and other similar plans, have not as yet been sufficiently substantiated by experiment. So far as I know, we have only one experiment on the comparative value of manure made under cover and without, that of Mr Campbell of Craigie, to which I referred at the meeting; and I mention the matter again here, because it will be doing a good service to the progress of agriculture if any of our members could be induced to institute an extended series of experiments on this subject. And should any one be inclined to do so, I would beg to direct their attention to the method in which, as it appears to me, the experiments should be made. The only method of arriving at satisfactory results would be, to take two lots of cattle, fed under precisely similar circumstances, and after preserving the manure of the one under cover, and of the other in the open dung-heap—the treatment being in all other respects the same—to ascertain, first, the total weight of the manure produced in each case; and, secondly, the relative effects of the application of equal quantities of the two sorts to the same crop. The former of these precautions I consider of much importance, as I do not anticipate that a *very* great difference in the value of the two sorts, weight for weight, will be found; but should rather expect that the advantage of the covered dung-heap will be found in the facilities which it gives of preventing waste, and causing the production of a large quantity of manure of average quality.

The condition in which farm-yard manure should be applied is a question which has been fully discussed by several of the speakers, and the general opinion is, that in autumn it should be applied in a fresh state, but that in spring it should be well and thoroughly rotted. Such, I need scarcely say, is the general opinion, and it is that also to which we should be directly led by theoretical considerations. The rotting of manure is, in fact, the conversion of its nitrogen into ammonia, the state in which it is absorbed by the plant; and when the manure is to lie long in the ground before that process is to take place, it is obvious that, the smaller the quantity of its nitrogen that has been converted into the condition

of the volatile and soluble ammonia, the less likely will it be to lose by protracted exposure to the vicissitudes of the winter. Exactly the reverse of this should be the farmer's object when he applies his manure in spring. He must then endeavour to have as much of its nitrogen in the form of ammonia as possible, as we know well that the abundant supply of that substance is most valuable in giving a start to the young plant, and bringing it rapidly through the first stage of its tender existence. Such should obviously be the system, where farm-yard manure alone is to be employed; but it is worthy of observation that the rotting or fermentation of manure can scarcely be carried on without at least some loss of ammonia, and it has frequently struck me that, now that we can obtain guano, sulphate of ammonia, and the ammoniacal manures, theoretically, the best and most economical method of applying farm-yard manure would be to use it unrotted, and to mix with it a sufficient quantity of one or other of these substances, to supply the ammonia requisite for starting the plants. Mr Main communicated to the meeting the results of a very interesting experiment, in some respects confirmatory of this view, for he found that the best results were produced when a smaller quantity of manure was employed along with a certain proportion of guano. All the manure he applied in this experiment was, however, well rotted; but he gave the results of another experiment, in which equal quantities of rotted and recent manure were employed for turnips, and the latter produced by much the best effect. This experiment and its results are certainly at variance with what has hitherto been the practice established by experience, and I trust it will be carefully repeated, because, should the results be confirmed, it will create a very great change in our agricultural practice. In fact, Mr Main finds that 28 tons of recent manure produce a better effect than 28 of rotten; but any one acquainted with the management of a dung-heap knows that 28 tons of well-rotted manure correspond to a much larger quantity, perhaps 35 tons, of the recent manure; so that, if Mr Main's experiment be confirmed, not only will the application of the manure in a recent state produce a better crop, but there will be also a very great economy in the quantity employed. The question is one of great importance, and should not be lost sight of by our practical men.

It would occupy too much time if I were to attempt entering upon the observations made by the speakers regarding the other manures made upon the farm; but attention was directed to several other sources of manure, which, though of less importance than that of cattle, should not be neglected. Poultry manure was particularly alluded to, and estimated at about half the value of guano, which is probably not far from the truth; and it seems to me that its production is worthy of more attention than it has hitherto met with in Scotland, and might be coupled with the feeding of poultry, which would be a profitable matter in the

neighbourhood of large towns. Compost heaps were also touched upon by some of the speakers, though none enlarged upon their management; an allusion was also made to the importance of collecting vegetable and animal refuse of all kinds whatever, and adding them to the dung-heap, which Mr Finnie compared to the purse of the miser, in which the farmer ought to gather together and accumulate every unconsidered trifle, with the certainty that all he adds will eventually come to swell the profits of his agricultural operations.

The last discussion—on the most suitable proportions and quantities of grass and clover seeds to sow for hay, soiling, and pasturage; the substances most profitable for top-dressing, and the proper time to apply them—is that which least admits of satisfactory abstraction. It is remarkable for the amount of detail which it contains regarding the practice pursued in different parts of Scotland, and affords much valuable information on this subject from the districts of Mid-Lothian, East-Lothian, and Fifeshire. The information is, however, so varied, that I must content myself with a very cursory statement of what seem to be the most important matters, and must refer my audience to the detailed report of the meeting for such questions as cannot be embraced in my short resumé.

The whole of the speakers concur in the opinion that, when the land is not clover-sick, red clover, with annual and Italian ryegrass, forms by much the most profitable mixture for hay or soiling; but as to the relative proportions of these seeds, considerable though perhaps not very material difference of opinion exists. Mr Scott employs 10 lb. of each of these seeds, but most of the other speakers employ a smaller quantity of clover. When, however, there is reason to expect a failure of red clover, then it is considered advisable to substitute for it a quantity of white or alsike clover or cow-grass, and a small quantity of yellow clover. The introduction of the latter substance, however, seems to be a matter about which a very great deal of difference of opinion exists;—it is condemned by some of the speakers as wiry and innutritious, while others hold exactly the opposite opinion, and have found it to be readily and greedily eaten by cattle. When the grass is sown for pasturage, and is intended to be left for more than one year in that state, a very different system of sowing must be adopted. The farmer's object, then, is not to produce a bulky crop at any one period, but to arrange matters so that there shall be at all periods of the year a sufficient quantity of herbage. For this purpose the quantity of red clover must be greatly reduced, and that for two reasons,—first, because it rarely appears on the second year; and second, because, from its broad and leafy character, it is apt to choke up and retard the growth of the other plants which require to be mixed with it: and a variety of other species must be employed and arranged in such a manner that they shall come to maturity at successive periods, so that at no time shall the pasturage

be bare or imperfectly covered. Different proportions and quantities of seeds are recommended for this purpose, but the general principle held in view was the substitution of perennial for annual plants. Thus, we have recommended rough cocksfoot, meadow fescue, timothy grass, perennial ryegrass, and the various species of clover; and it appears certain, from the testimony of the speakers, that the larger the number of species sown the better will be the pasture obtained. This opinion, however, is contested by Mr Douglas, who thinks that in general the number of species sown is too large, as he has observed that, after land had been some time in grass, the greater number of the species sown disappear, and are replaced by others more congenial to the soil and climate. It occurs to me, however, that this is not so much an objection to the system, as an indication that more minute attention requires to be paid to it, and that probably the species sown would require to be varied, to suit the habits of each individual farm. Some advantage would, at all events, be gained by observing the species which are naturally most abundant in any locality, and sowing them in preference to others. It is a well known fact, that in old pasture the number of species is very large; and several hundreds may easily be detected in a moderate-sized field. Nature here indicates the course which we ought, as far as possible, to endeavour to pursue; but we must beware of imagining that we can in all cases produce the same plants as those found after land has been years in grass,—it being a well substantiated fact, that the species growing undergo considerable changes in successive years. The attempt, at all events, should be made to imitate nature as far as circumstances will admit.

The different speakers have entered at considerable length into the best substances for top-dressing; and it seems to be the opinion that, though farm-yard manure is very valuable for this purpose, it can be employed more profitably in other ways, and that the attention of the farmer should be confined to portable manures. Of these substances, all the speakers concur in giving the first place to sulphate of ammonia, guano, and nitrate of soda; and, in the observations I made at the meeting, I pointed out that these substances were the most abundant sources of nitrogen, which we know to be the most important element which our manures supply. It appears, indeed, that the value of these substances may be measured by the quantity of nitrogen they contain. Mr Scott, at least, has given us some most interesting data for the solution of this question. He informs us that he had found equal effects from

1¼ cwt. Sulphate of Ammonia.
1½ cwt. Nitrate of Soda.
2 cwt. Peruvian Guano.

Now, these are not far from the quantities which would yield equal amounts of ammonia, supposing the whole of the nitrogen they contain to pass into the state of that compound. I gave, at the

discussion, a hurried calculation of these quantities; but, on more careful calculation, I find, supposing the substances to be of good quality, that in these manures there was supplied nitrogen enough to yield the following quantities of ammonia:—

Sulphate of Ammonia,	32	lb.	Ammonia.
Nitrate of Soda,	33	„	„
Peruvian Guano,	37	„	„

in which the differences are very trifling. A matter, however, which I consider of very high importance, and well deserving of the further attention of the agriculturist, was referred to by different speakers;—It was stated that the effects of sulphate of ammonia or guano, conjoined with nitrate of soda, were always greater than those of either separately; and that the result of observations had shown that sulphate of ammonia was most beneficial to clover, and nitrate of soda to the grasses. I have since had this observation confirmed by several other practical men; and one especially informed me that he had formerly employed nitrate of soda in considerable quantity, and with beneficial results, but having latterly adopted the practice of sowing a very large quantity of clover, with only a trifling amount of ryegrass, he has no longer found any advantage from the application of nitrate of soda, while guano and sulphate of ammonia produced a very decided effect. Now, these facts point to a matter of much importance both in a practical and theoretical point of view, as they serve to show us that we ought to consider not merely the elements supplied to the plant, but the state of combination in which they exist,—that an element may in one state be of great value to the plant, and in another of little or none; and that the condition most suited for one class of plants may be exactly that least adapted for others.

I shall now conclude these remarks by again expressing my high estimation of the value of our discussions, and of the important facts which they have brought out, to which, I fear, I have not by any means done justice. My original intention was to have given a more minute resumé of the opinions of each speaker—in fact, to have given each discussion in a condensed form—but I found that any such plan was incompatible with the length of time to which I felt myself restricted. I was therefore compelled to adopt a different plan, and to gather out these facts and statements, which occurred to me to be most important and valuable. I am not at all certain that I have done this in the best manner possible, and I fear I may have omitted many matters deserving detailed notice. Amidst the great number of facts, sometimes not easily reconciled with one another, I have found some difficulty in making my selection, and I have no doubt that a reperusal of the whole of the discussions will be found to supply much valuable information; and should my observations have the effect of inducing any of our members to do so, my object will have been fully gained.

PROCEEDINGS IN THE LABORATORY.

By THOMAS ANDERSON, M.D., Chemist to the Highland and Agricultural Society.

ON THE COMPOSITION OF THE STEEP-WATER OF FLAX STEEPED BY SCHENK'S PROCESS.

MY attention was some time since drawn to the composition of the steep-water of Schenk's patent process for the preparation of flax, by Mr Hodgson of Carham Hall, who was desirous of ascertaining whether the fluid obtained as the refuse of this process was sufficiently rich in the valuable constituents of the flax to admit of its being profitably carried back to the farm, and applied as a manure to the land. The patent process in question is very simple, and is in reality nothing more than the application of a moderate heat to the water employed for steeping. A large vat is employed, in the lower part of which a steam pipe is coiled. The fresh flax is filled in and simply covered with water, and, a current of steam being admitted through the pipe, the temperature of the whole is gradually raised to a point considerably under boiling, and is kept in this state for some hours. The fluid is then let off, and the process of steeping is complete.

An imperial gallon of this steep-water was found to contain the following substances:—

	Grains.
Organic matter,	114.91
Inorganic matter,	176.26
Total matters and solution,	291.17

The 176.26 grains of inorganic matter contained—

Silica,	0.60
Peroxide of iron,	2.33
Lime,	18.17
Magnesia,	10.51
Potash,	18.12
Soda,	15.66
Chloride of sodium,	65.15
Sulphuric acid,	24.89
Phosphoric acid,	1.88
Carbonic acid,	18.95
	176.26

The organic matter contained 3.19 grains of nitrogen, corresponding to 3.88 grains of ammonia.

The water employed for steeping contained in one gallon—

Organic matter,	6.80
Inorganic matter,	49.60
	56.40

It is probable that the greater part of this inorganic matter consisted of salts of lime and common salt, and that this is the source from which a large proportion of those substances obtained in the analysis of the steep-water was derived, the remaining constituents in the latter being extracted from the flax. It is obvious, from the analysis, that the value of the steep-water is not sufficiently great to permit its being carried back to the farm from which the crop was taken, but it might be advantageously applied

to land in the immediate vicinity of the manufactory by means of irrigation, or even through pipes, as is done on some farms with liquid manure. It must be understood, however, that the steep-water has only about half the value of liquid manure.

I am very far from desiring to encourage anything like the carelessness which has been too common on many farms in the preservation of valuable matters, but I am inclined to think that the employment of flax-water as a manure is something of an over-refinement, and that flax may be grown without its being requisite to save the steep-water, provided the linseed be consumed upon the farm. Flax is an exhausting crop, simply because, in the ordinary method of cultivation, the whole plant is removed from the land; and it is scarcely possible that it should produce a greater exhaustion than would be done by a grain crop, if we removed the whole of the grain, the straw, and even the stubble. And if, in the case of flax, the seed were consumed on the farm, I believe we should have less exhaustion than from a grain crop, in which we leave the straw and remove the grain, which contains by much the largest proportion of those elements which we have greatest difficulty in applying to the land.

ON THE COMPOSITION AND VALUE OF DISTILLERY WASH.

Distillery wash, or *dreg*, as it is usually called in this neighbourhood, has been pretty extensively used by farmers for the feeding of stock and as a manure, and much difference of opinion exists as to its value for either of these purposes. An analysis has been recently made in the laboratory of the dreg from the Sunbury distillery, near this. An imperial gallon was found to contain in solution—

	Grains.
Organic matter,	4127.9
Ash,	276.1
Total solids,	4404.0

The 276.0 grains of ash contained—

	Grains.
Earthy phosphates,	73.7
Phosphoric acid in combination with alkalis,	61.0
Potash,	34.4
Soda,	52.3
Sulphuric acid, chlorine, &c.	54.7
	276.1
Quantity of nitrogen in the organic matters,	243 grains.

These results would indicate a very considerable value for this substance, both as food and as manure. Two other analyses less complete than the foregoing, however, show that it is liable to extremely great variations. They gave the following results :—

No. 2.

	Grains.
Organic matter in one gallon,	2402
Ash,	258
Total solids,	2660

No. 3.

	Grains.
Organic matter in one gallon,	184.67
Ash,	19.01
Total solids,	203.68

The ash contained—

Earthy phosphates,	7.62
Phosphoric acid in combination with the alkalis,	2.83

The organic matter contained . . . 9.79 grains nitrogen.

It is clear from these results that the first sample is very nearly twice as valuable as the second, and *more than twenty times* as valuable as the third. I am not aware of the causes of this great difference, but it is probably dependent upon the different methods of fermentation employed in different distilleries. The first sample was sent as a fair specimen of the refuse of the work from which it came, and the second was sent by Mr Finnie, who, at the time, supposed it to be a fair sample, but who afterwards informed me that he believed it to be considerably above the average. If No. 1 represented the usual composition of the substance, it ought to be of great importance in feeding cattle, as it contains about as much nutritive matters as are found in two-thirds of its weight of turnips, or 15 gallons of dreg should be equal in value to 100 lb. of turnips. Of No. 3, however, no less than 300 gallons would be required to replace 100 lb. of turnips. I imagine that both these are extreme cases, and that the average composition of dreg lies somewhere between the two—at all events, the immense difference in the results of different quantities should serve to put the farmer and dairyman on their guard, and prevent them purchasing at the same price all sorts of dreg, without taking into consideration its nutritive value.

As far as the use of this substance, as a manure, is concerned, the same remarks are, of course, applicable—the most concentrated being also the most valuable. I have been informed by practical men that its effects are equal to those of liquid manure; but if as concentrated as the first sample, it ought to be much superior, and if as dilute as the third, decidedly inferior; and the difference may be readily seen by a comparison of the quantities of nitrogen and earthy phosphates contained in a gallon of each.

		Distillery Refuse.	
	Liquid Manure.	No. 1.	No. 3.
Nitrogen,	21.5	243.0	9.79
Earthy phosphates,	44.5	73.7	7.62

The first of these is obviously much superior to liquid manure; but if the farmer can rely on obtaining such a substance, he would act more wisely to use it as food than to apply it as a manure. If, on the other hand, he can only obtain it like No. 3, the less he has to do with it the better.

Note.—As the space allotted for the communications from the Laboratory in this Number was not sufficiently large, the conclusion of the turnip investigation is unavoidably postponed till next Number.

ON FEEDING AND SHELTER CONNECTED WITH DISEASES IN CATTLE AND SHEEP.

By Mr FINLAY DUN, Jun. V. S. Lecturer on Materia Medica, &c., at the Veterinary College of Edinburgh.

[Premium—The Medium Gold Medal.]

I PURPOSE dividing the following paper into two distinct sections. In the first section, I shall consider the proper methods of feeding cattle and sheep, and the diseases induced by improper methods of feeding; and in the second, the effects of exposure to rain and cold, the advantages of proper shelter, and the evils of insufficient shelter, adverting also to the influence of drainage of the soil on the sanitary condition of cattle and sheep.

I. Dietetics, as applied to cattle and sheep, is a subject of wide extent and great importance, but one which has as yet been very imperfectly investigated. Within these present narrow limits it is impossible to discuss the subject fully; but I shall endeavour to illustrate it as far as my space permits, by dividing it into the following heads:—

1. The quantity of food requisite for the healthy existence of cattle and sheep, and the evils resulting from over or deficient feeding.
2. The nutritiveness of food, and the proportions of nitrogenous and non-nitrogenous matters which it should contain.
3. The advantages of a variety of food, and of a due preparation of it.
4. The proper regulation of the times of feeding.

1. *Quantity of food.*—It is found from experience that a healthy ox consumes nearly one-fifth of its own weight of turnips daily, or about one-fiftieth of its weight of hay, straw, and such other dried food. Cattle of 50 stone imperial weight, allowed straw *ad libitum*, will consume from 150 to 180 lb. of turnips daily. Boussingault considers as a sufficient allowance 6 lb. of mixed food or 4 lb. of hay for every 100 lb. of living weight; or otherwise, about 30 lb. per day of a mixture of equal parts of grass and hay for cattle of 30 stone imperial weight. The food of cattle requires to be of a certain *bulk*. Without this, digestion and assimilation are not properly performed, even although the food be sufficiently nutritive. In order that digestion be effectually performed, the stomach must have a certain mechanical stimulus, which the bulk of the food naturally imparts to it. But the quantity of food necessary for an ox must of course be greatly modified by various circumstances. It is evident, for instance, that young animals, in proportion to their size, require a larger quantity and a better sort of nutriment than adults. This depends upon their having to increase the size of all the parts of their frame, as well as to repair the continual waste, which is also greater in them than in older animals, on account of their taking a greater amount of exercise.

At all ages, exertion greatly increases the demand for food, and prevents the accumulation of fat. A man, when employed in active out-door labour, requires a much more nutritive diet than when pursuing a sedentary occupation within doors. Working cattle also require a larger quantity, and a more nutritive quality of food, than similar animals confined to courts or tied to the stall. Wild animals and those allowed to roam about rarely become fat. It has been remarked by Liebig that cows driven long distances to pasture, unless they get an extra supply of food, yield milk poor in caseine—the materials which would otherwise have formed that constituent of the milk being used in repairing the waste of the muscles and other parts employed in locomotion. But without dwelling further on this point, we shall only remark, as a corollary to what has just been stated, that, in the economical fattening either of cattle or sheep, they must be prevented from having any very considerable amount of exertion; and hence it is urged, and I think with reason, that the system of stall-feeding is more *expeditious* than that of court-feeding. In determining the relative merits of these two systems, it must, however, be borne in mind, that the latter has some advantages which more than compensate for the longer time the animals are kept; for, in curtain feeding, the fat accumulated is more equally laid on, and of a firmer consistency; and, in consequence of their turning out better than their appearance would warrant, cattle so fed are more prized by the butcher, and bring a somewhat higher price than those that are stall-fed. The improvement of cattle, as regards weight, often varies even when they receive exactly the same food; and it is therefore very difficult to know what weight will be produced in a given time by a given quantity of food. During the winter months, well-bred, carefully-selected, two-year-old cattle, liberally supplied with ordinary nutritive food, should improve at the rate of 1½ or 2 stones imperial per month. This average may by some be considered as too high, but in many localities, both in England and Scotland, early maturity and speedy fattening are much impeded in consequence of the cattle being coarse and unimproved, and also in many instances badly reared. Such animals, even with the best feeding, grow very slowly, and yield a very poor return for the large quantities of food they consume, and the long time they require to be kept before being fit for the butcher.

Over-feeding.—Occasional over-feeding is productive of various evil consequences, the most common of which are derangement of the digestive organs, hoven, and diarrhœa. Amongst cattle and sheep *habitual* over-feeding is not common. The only disease of frequent occurrence directly traceable to it is enlargement of the liver, which, however, is often met with amongst highly-fed cattle and in the byres of most large towns. It is readily detected by yellowness of the skin and mucous membranes, and more or less irregularity of the bowels, but is seldom, except in aggravated

cases, productive of any very serious symptoms. This variety of liver disease depends on the constant excessive secretion of bile required by the ingestion of large quantities of highly stimulating food. To enable the liver to secrete the larger quantity of bile thus required, the size of the organ is gradually increased. When cattle for any considerable time get excessive quantities of undigestible food, they are very apt to suffer from fardel-bound; but as this disease depends chiefly upon the bad quality of the food, we shall not notice it farther at present. Over-feeding tends greatly in cattle, as in all other animals, to develop a plethoric state of body; and hence it occasionally gives rise to puerperal fever, and to that congestive disease so fatal in some localities to young cattle, and known under the name of black-quarter, or inflammatory fever. It must be stated, however, that continued over-feeding does not directly produce these diseases, but only develops any inherent tendency to that peculiar state of body on which they depend.

Deficient feeding.—Amongst the lower animals, deficient feeding is far more common than over-feeding, and is productive of far more serious and lasting evils. A system of diet may be deficient from one of these two causes—from insufficiency in quantity or from insufficiency in nutritiveness. These two errors, however, usually co-exist, and their general effects are the same—they act on the health in the same injurious manner, and predispose to similar diseases.

The first apparent effects of insufficient food in cattle and sheep, and indeed in all animals, are dulness, languor, and indisposition to move about; and this is especially observable in young animals, in which we naturally expect more activity than in adults. The hair becomes rough and staring, and the skin hard, dry, and adherent to the ribs—the effect of the absorption of the cellular tissue lying between the skin and the adjacent muscles. The skin becomes scurfy, and lice abound. Diarrhœa appears, and is often one of the earliest, as it certainly is one of the most invariable, indications of a faulty system of diet. Wounds and sores are slow in healing, and are liable to take on an unhealthy action. The belly becomes tucked up, the back somewhat roached, the bones very prominent, and the animal has a general ragged appearance. The fat, and by-and-by other tissues, are absorbed and enter the circulation, to afford materials which, by uniting with the oxygen of the air, support animal heat. It is curious to observe that, in the breaking up of the system, the fat and such other superfluous tissues are first removed, while the diminished quantity of blood is chiefly appropriated to the nourishment of the brain and nervous system, and other parts whose unimpaired integrity and healthy condition are essential to life. The strength rapidly fails, the blood becomes thin and impoverished, serous effusions present themselves underneath the jaws and in various dependent parts of the body, and death soon follows. The latter and more fatal

symptoms of starvation are, however, of rare occurrence; but those of less intensity are exceedingly frequent, and, although often slow and even imperceptible in their progress, they eventually become apparent in the retarded growth, diminished vigour, and functional derangement, which sooner or later follow the continued operation of a system of insufficient diet.

Deficient diet, however, cannot, strictly speaking, be considered as an exciting cause of disease, but it is often a predisposing one, and in its mode of operation is exactly similar to that of other debilitating influences, inasmuch as it induces prostration of the vital energies, and hence diminishes the power of resisting ordinary morbific causes. But insufficient diet, besides increasing the tendency to disease, also aggravates its severity when it does occur, by rendering it more liable to take on untoward forms and lead to unfavourable terminations. Under its debilitating influence, acute inflammations generally become sub-acute or chronic, the fever attending them lapses into the typhoid form, and convalescence is unusually protracted. While, then, we deny that insufficient food is of *itself* adequate to produce disease, we admit that by its depressing influence it prepares the system for the reception of disease, rendering it incapable of bearing up against the attack, and becoming, when in combination with direct morbific causes, a fertile source of sickness and mortality.

When deficiency of food exists in connection with other sorts of mismanagement, its bad effects follow with unusual rapidity and severity. Thus, deficient drainage and ventilation, and the breathing of an impure air, aggravate in the most marked degree the evils arising from insufficient food. This is well exemplified in the indifferent health and liability to disease of cows kept in most large towns. Cold also aggravates hunger, and an excessive exposure to it renders a larger quantity of food necessary to maintain the animal powers unimpaired. It has also been observed that animals of delicate and highly-artificial breeds, of unhealthy habit, or such as may have a predisposition to *phthisis pulmonalis*, or to *dysentery*, require a generous diet, and bear ill any restrictions in the quantity, or any deterioration in the quality, of their food.

On the other hand, when animals are placed in favourable circumstances in regard to the breathing of pure air, cleanliness, warmth, and general health, a slight insufficiency of food may be continued for a very considerable time without producing any strongly-marked bad effects. Even when the system of diet is exceedingly defective, healthy animals generally bear up for some time under its depressing influence, and it is only when the evil is continued that its bad consequences become evident. This fact deserves consideration, as there are many who erroneously suppose that, if any particular course of diet is faulty or deficient, its evil consequences on the health of animals subjected to it would *at once* become apparent. This, however, is by no means the

case, for both cattle and sheep seem able to maintain health for some time, even on very deficient and innutritious food ; and hence we must be cautious in assuming that any particular allowance of food is capable of permanently supporting the vital energies, merely because such an allowance may have been found sufficient during a few weeks. The truth of these statements, and the necessity of attending to them in the management of the domesticated animals, may be further shown by reference to the annals of human medicine. Thus, in the case of the scurvy which broke out during the spring of 1847, in various parts of Great Britain, and especially among the railway labourers in the south of Scotland, the bad diet to which the disease was traced had, in the great majority of cases, been persevered in for a period of time varying from three to twelve months, or even more, before any symptoms of the disease became apparent.* So also in other scorbutic epidemics, whether occurring on land or at sea, the error in diet does not immediately, but only after a variable and often considerable period, develop its worst effects. Some considerable time also elapses before the appearance of diarrhœa, which in man, as in the lower animals, is one of the most unfailing results of an ill-regulated or defective diet.

There are few aspects in which insufficient food appears to greater disadvantage, or in which its evil consequences are more obvious, than when viewed economically—that is, as a mere matter of pounds, shillings, and pence. When occurring frequently, or continued long, it materially retards the animal's progress towards maturity, prevents the accumulation of fat, and lessens the secretion of milk. Such consequences necessarily cause a loss to the breeder, the rearer, or the feeder ; and the loss thus occasioned far exceeds the gain that may have been derived from any difference in the cost of feeding. The stinted calf often carries about with it for months, and even years, the unmistakable effects of an ill-judged economy in regard to its early aliment; and an animal reared upon an insufficient diet is always much more difficult to get into good condition, and requires a much longer period to fatten, than one which has always received a sufficient quantity of food, and been kept growing from its birth.

Having offered these remarks on the general effects of insufficient food, I shall now proceed to examine in detail its particular effects, as observed in the different stages of the animal's growth.

Animals, even before birth, may be affected by insufficient food. This occurs more often, perhaps, than is generally believed; and in all cases in which the mother, while pregnant, receives a deficient quantity of food, the supply to the fœtus must necessarily be diminished. This retards its development, especially as the period of parturition approaches ; and at birth it will often be found in a very weakly state, from which it will require

* *Monthly Journal of Medical Science,* July 1847.

several weeks to recover. But insufficient food during pregnancy, besides retarding the development of the young *in utero* and thus rendering it small and weakly at the time of birth, has also the injurious effect of curtailing the provision necessary for its future sustenance; or, in other words, the allowance of food is too small both for the support of the mother and for the secretion of milk. The milk secreted is small in quantity, or, if the quantity be at all considerable, it is exceedingly poor in quality; nor will even the most liberal aliment given after the birth of the young one remedy in all cases the past evil, or restore the milk to a proper condition, either as regards its quantity or its quality. On the contrary, the quantity of milk yielded by a cow that has been starved during pregnancy will seldom, even with the most liberal diet after parturition, equal that yielded by a similar cow well fed during the period of pregnancy, and especially during its latter stages. If, then, a liberal diet during gestation is capable of influencing the vigour of the young animal, and the production of the milk which is subsequently to supply its wants, at least for a time, surely it is false economy to put pregnant cows on an over-restricted diet. Such mismanagement, when pushed to extremity, may be fraught with very serious consequences both to the mother and her offspring. The strength of the former may be so reduced as to make parturition tedious and difficult, while the vital energies of the latter are either altogether inadequate to the maintenance of its life, or so depressed as to render it for a long time puny and weakly, and hence exceedingly liable to suffer from the attacks of disease. The effects of a deficient supply of nutriment to the calf or lamb during gestation is well seen in cases of twins, one or both being always considerably below the average size, and the difference of size often continuing to be observable for many months.

There is no period in the life of an animal in which the effects of insufficient food are more prejudicial, or more lasting, than in early years: and the reason of this is obvious, for an animal, in its progress from birth to maturity, requires, besides the ordinary quantity of food necessary for the supply of the vital waste, an additional quantity for the increase of all its parts.

There is, perhaps, no department in the rearing or feeding of cattle in which there is so much mismanagement as in the bringing up of calves, and certainly none in which a misplaced economy so completely defeats its object. The calf, after a week or ten days, should be liberally supplied with milk, and for six or eight weeks should receive only new milk. This should be given in quantities of from eight to ten imperial pints *per diem*, and divided into at least three separate meals. Skimmed milk may be gradually substituted for a part of the new milk; and although milk ought, during three or four months, to form its principal food, the young animal should be gradually accustomed to other

sorts of diet, and especially to oil-cake, so that the weaning may be thereby more easily effected, and the change in the nature of the food gradually brought about. While the adoption of such a system of diet insures, during the period of lactation, a continuous and steady improvement, insufficient food, on the other hand, is attended by various evil consequences. It causes general debility, increased predisposition to disease, retarded growth, weakness of the limbs, inability to rise, and extreme emaciation. And further, by causing excessive hunger and voracity, it has the indirect effect of producing choking, and that species of indigestion so common in carelessly-fed calves, arising from the accumulation of the curdled milk in the rumen or first stomach.

The bad effects of an insufficient quantity of milk upon the young animal are well shown in the case of two lambs put to suck one ewe. Lambs thus suckled are always inferior to the majority of the single lambs of the flock in weight, condition, and strength; and it is generally some months after weaning before they make up for the deficiency of their early supply of milk. And, indeed, unless the insufficiency be slight and speedily remedied, the future health may suffer, and the future aptitude for fattening be materially lessened.

During the summer and autumn months of the first year of their existence, cattle and sheep should always receive an abundance of food of the best quality, as they are during that time exceedingly liable to suffer from even slight deficiencies of diet. It is also of much importance that calves be brought within doors early in the season, or at all events housed during the night, before the weather becomes cold and inclement. Indeed, the early housing of all cattle is of the greatest importance to their health, for if kept out too long in autumn they often lose condition, which they are sometimes slow in recovering.

After the close of their first summer's grass, young cattle are generally placed in sheds or courts, but their feeding often receives too little attention. The turnips, potatoes, oil-cake, and the other more nutritious articles of food, are in great part reserved for the older stock; and the calves, now varying from six to twelve months old, get little else than straw. In some parts of the country a system such as this is the general practice of the farmer.* But

* In those parts of the country where due attention is bestowed on the rearing of cattle, the usual practice during the first winter is to give straw, a few turnips, and a good allowance of oil-cake or linseed. When so treated, the cattle improve both in size and condition—are less liable to the various diseases incident to this period of life, especially to congestive fever, popularly termed quarter-ill; they also thrive well when turned out to grass in the succeeding spring, and, if well grazed, may be sold off fat at two years old. Many breeders are of opinion, that if yearlings are fed during winter on straw, and enough of turnips to make the diet sufficiently nutritive, they do not improve during the summer, except upon very rich grass. But, by adopting the system now recommended—viz., reducing the quantity of turnips, and adding an equivalent proportion of oil-cake—the nutritiveness of the diet is maintained, and the animals improve more rapidly on ordinary pastures.

that it is not a judicious system is sufficiently evident from the fact that the animals subjected to it are, on the return of spring, turned out to grass with hard unthrifty coats, lank limbs, and pot-bellies—the natural results of a system of feeding which necessitates the consumption of a large bulk of food before the animal is able to extract sufficient nutriment from it. Moreover, animals so managed, when suddenly put upon a more liberal diet, become liable to various casualties, such as purgation, congestive fever, abortion, epilepsy, and various cerebral affections.

When insufficient quantity of food is conjoined, as it generally is, with defective quality of food, it impairs the tone of the digestive system, and produces intestinal derangement. Thus an innutritious, dry, and bulky food—such as straw—is apt, when used exclusively for some time, to cause distension of the rumen, constipation of the bowels, and impaction of the third stomach, which last constitutes the disease called fardel-bound. And when pushed to extremity, such a system occasionally gives rise to the very opposite effects—diarrhœa and dysentery.

The evil consequences of insufficient food are less felt as the animal reaches maturity, principally because it is more able to bear privations, and because the food consumed is now required to supply the vital waste alone, and not to add to the muscular or bony structures, as was the case in earlier years. The effects of deficient nutriment at this stage of growth are, however, very similar to, and only differ in degree from, those which obtain during the other periods of life. There is the same dulness, inaction, and loss of strength, which we have already described. There is no accumulation of fat, and no improvement in condition, for there are no materials afforded for the increase of the tissues, and these may indeed be barely sufficient to supply the vital waste. During this period of growth—namely, from two to three years—cattle are usually put up for fattening; and it is then that the evil effects of previous bad feeding are very remarkable, as evinced by the length of time required for fattening. On the other hand, animals which have been well cared for from the beginning, and have always received an ample supply of food, are distinguished by their smooth and pliant skins, their well developed forms, their rapid growth, and speedy fattening. It is also important to observe that these latter, although increasing in weight more rapidly than the others, consume a considerably less quantity of food—a striking evidence of the real economy of giving at all times a supply of food adequate to the wants of the system.

The effects of insufficient food are often speedily and unequivocally shown in the case of milk cows. In these even a slight deficiency of food quickly produces a corresponding decrease in the quantity of the milk, as well as a deterioration of its quality; and if the deficiency of food be very great, the secretion becomes after a time entirely dried up. In the management of milk cows,

nothing perhaps yields a more ample return than an abundant supply of nutritious food; and there is certainly nothing more inimical to the interests of the proprietor than a system of spare diet. In milk cows, more than in any other kind of cattle, an unusually large supply of food is requisite; for, in order to obtain milk, there must be not only a sufficiency of food to support the condition of the body, but also an overplus from which the milk may be formed. This fully accounts for the fact, that milk cows generally consume a considerably larger proportion of food than other cattle of similar weight, and in similar circumstances.

Insufficient food seems to produce in sheep effects not very different from those previously described as occurring among cattle. From the former being able to subsist on barer pasturages, and from their coming sooner to maturity, the injurious consequences of deficient nutriment are, however, sometimes less observable in them than in cattle. Thinness and lightness of fleece, coarseness and brittleness of fibre, general inferiority of the wool, and its easy separation from the skin, general debility and emaciation, excessive liability to attacks of the fly, to purgation, to dropsical swellings, to hydatids in the brain, to typhoid fevers and braxy, to skin diseases, and especially to scab, form part of the catalogue of evils which assail starved sheep.

2. *The nutritiveness of food, and the proportions of nitrogenous and non-nitrogenous matters which it should contain.*—The chief uses of food are to repair waste, increase growth, and support animal heat. There are certain sorts of food which fulfil respectively each of these purposes. All the substances which add to the weight of the body, and repair the waste of its more highly organised parts, contain nitrogen, and are in consequence called *nitrogenous* or *azotised.* From the purposes they fulfil in the animal economy, they are also termed *sanguigenous*, or flesh-producing principles, and by Liebig "plastic elements of nutrition." The caseine or curd of milk, the albumen of turnips, and the albumen and fibrine of oats and of wheat, are examples of this class. There is another large class of substances of which starch, sugar, and fat are examples, which contain no nitrogen, but are rich in carbon, and are therefore called *non-nitrogenous*, or carboniferous. They cannot form muscular or other organised tissue, but are consumed in respiration and in maintaining animal heat, and are hence termed *calefacient.**

* Of late years chemistry has led to many great improvements in almost every department both of scientific and practical agriculture. It has afforded satisfactory explanation of the advantage and success of many of the operations of the farmer, and the disadvantage and failure of others; while the conclusions at which it has arrived, when carefully studied and judiciously applied, have ever been consistent with practical experience. In no department, however, have its advantages been greater and more obvious than in the feeding of animals. It has done much both to simplify and elucidate the true principles of dietetics, and has thus led to a far more judicious, certain, and successful practice, than could have been attained

Every system of diet, sufficient to support for any considerable time the life of any of the higher animals, must contain a certain proportion of substances of each of these two above-mentioned sorts of food. Animals fed exclusively on pure fibrine, caseine, or albumen, invariably die in a short time, and with all the symptoms of starvation. Such a diet is insufficient, from the absence of elements capable of supporting heat; and is also unfit even for the nutrition of the muscular, and such other tissues, from the want of fat necessary to form organised cells. On the other hand, an exclusively non-nitrogenous diet is also entirely inadequate to the continued support of life—and animals restricted to such food die within a few weeks, of absolute inanition. Such a diet is defective, from the want of materials for replacing the waste of the organised tissues, which require for their healthy growth certain proportions both of nitrogenous and non-nitrogenous matters.

But in addition to a requisite proportion of sanguiferous and of calefacient elements, there must also be present in the food of animals a certain quantity of mineral or inorganic matters. Without phosphates, no bones, muscles, or any organised tissues, can be formed; without common salt, no secretion can be elaborated; and without iron and alkalies, the blood itself could not undergo that process of continual renovation so essential to its healthy state. The insufficiency of pure azotised matters, or of pure fat, sugar, or starch, to support life, is by many ascribed,

by mere empirical observation. Amongst many other things, it has taught us, as above stated, the special purposes served in the body by different sorts of food; it has shown why certain articles of food are so much more valuable than others—why, for example, beans and oats are more nutritive than potatoes or turnips; and, by analysis alone, it often predicts the exact dietetic value of a new substance, and that even before it has been tried as food. Again, chemistry has satisfactorily ascertained that there exist, in vegetables, substances exactly or very closely analogous to those which form animal tissues;—that vegetable albumen, for example, such as exists in turnips or potatoes, is the same as the albumen of blood, and very nearly the same as the albumen of eggs;—that the fibrine of the *cerealia* is the same as the fibrine of blood, and the vegetable caseine or legumine found in peas and beans corresponds exactly in composition, and also in chemical and physical properties, with the caseine or curd of milk. From this it is obvious that the herbivora and graminivora, no less than the carnivora, receive ready formed in their food all the constituents necessary for the formation of red blood, muscle, milk, and every part and tissue of their bodies. Thus is realised with scientific accuracy the truth of the well-known observation of the Psalmist, "that all flesh is grass."

Further, it is ascertained that these three important alimentary principles, albumen, fibrine, and caseine, are so analogous in composition, that they are mutually converted into each other. This transmutation can be effected in the chemist's laboratory, as well as in the animal body; and affords a satisfactory explanation of the otherwise inexplicable phenomenon of the conversion of milk from blood, as in the milk-giving mother; and the reconversion of the milk into blood, as in the body of the sucking offspring. In the former case, we have the albumen and fibrine of blood converted into the caseine of the milk; in the latter case, the caseine is modified into albumen and fibrine. The presence of *any one* of these flesh-producing elements in food (containing a due amount of calefacient elements) is therefore quite sufficient for the preservation of life and health—animals being endowed with the power of forming from any one of these principles either, or both, of the other two. Thus, if a cow be abundantly supplied with beans, which are rich in vegetable caseine,

and we think with reason, to their containing a proportion of mineral matters too small to replace the quantity excreted.*

In all sufficient dietaries, either for man or animals, we find constituents of each of these three kinds: In milk, a type of what all dietaries ought to be, we have representatives of each—the caseine, a nitrogenous and flesh-producing principle; the butter, and milk-sugar, non-nitrogenous and calefacient principles; the inorganic materials, and especially phosphates, requisite in early life in unusually large quantity for the growth of the osseous tissues. And so it is with all other articles of food capable of supporting life—they all contain a certain proportion of nitrogenous or flesh-producing, of carbonaceous or heat-producing, and of inorganic matters.

In a system of diet, the *proportion* of nitrogenous and non-nitrogenous principles is a point of the first importance. An excess of either is attended with waste. When the respiratory principles are deficient, and the flesh-producing in too great proportion, the latter are broken up to supply the respiratory process. The most valuable parts of the food are thus misappropriated, and employed for a purpose which would have been more cheaply and efficiently served by any of the non-nitrogenous principles. On the other hand, the respiratory or heat-producing matters of the food, unless united with a fair proportion of some one or other of the substances belonging to the other great class, are quite

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there will be formed from them not only the caseine of milk, but also, by a very slight isomeric transmutation, the albumen of its blood, and the fibrine of its muscles.

Amongst the non-azotised substances, equally interesting changes occur. Not the least important of these is the conversion of starchy and saccharine matters into fat. When the food contains normal proportions of nitrogenous and non-nitrogenous matters, and when the animals receiving such food are allowed an ordinary amount of exercise, the oxygen taken in at each inspiration is sufficient to convert almost all the starchy and saccharine matters into carbonic acid and water. By this process of oxidation or slow combustion, animal heat is maintained. But in the normal process no fat is formed. When, however, the starchy and saccharine matters are consumed by animals in quantities so large that the oxygen inhaled is insufficient to convert them into carbonic acid and water, they lose a certain proportion of the hydrogen they contain, and are converted into fat, of which the excess is stored away in the cellular tissue. But in the bodies of animals there is also another process by which fat is believed to be formed, and which goes on simultaneously with that just described. The starchy and sugary principles are subjected to the influence of a ferment (which some suppose is produced in the liver), are broken up into less complex forms, and water, carbonic acid, and hydrogen being separated, the essential elements of fat remain. On this subject Liebig remarks—"We regard the formation of fat as the result of two processes, which occur simultaneously. One is an imperfect process of oxidation (of decay or eremacausis), by which a certain amount of hydrogen is separated from the elements of sugar; the other, a process of splitting up a complex atom (of fermentation), by which a certain amount of oxygen is separated from the elements of sugar in the form of carbonic acid."—*Familiar Letters on Chemistry*, p. 377.

We take the present opportunity of particularly recommending this work to the perusal of Agriculturists. It contains a great deal of very interesting and valuable information, conveyed by the English translator in an admirably clear and attractive style.

* LIEBIG'S *Letters*, p. 382-3.

inadequate for healthy nutrition. Even for the formation of fat—itself a non-nitrogenous substance—principles of each class must exist in the food; and it is therefore a great error to suppose, that because fat contains none of the flesh-producing substances, it can be formed without them. It certainly requires for its formation a less proportion of these than is necessary for the growth of the muscular tissues; but there is no system of diet remarkable for its fattening properties which does not contain a considerable proportion of nitrogenous matters. In approved dietaries for large bodies of men, the proportion of nitrogenous and carbonaceous matters is about 1 of the former to 4 of the latter. When exertion is great, the proportion of nitrogenous matters requires to be increased, as is done in the case of the navy allowances, which contains 7.54 of nitrogenous, and 20.90 of carboniferous principles. When, on the other hand, the occupation is light and sedentary, and the persons live principally within doors, the quantity of nitrogenous principles may without detriment be somewhat diminished. The food of horses performing severe and continued labour should contain 1 part of nitrogenous to 4 or 5 of carboniferous matters; and for cattle and sheep, the most economical proportions are 1 of the former to 7 or 8 of the latter. From the rapidity of their growth, young animals require a more highly nitrogenous diet than adults; and we accordingly find that fully one third of the nutritive matters of milk consist of nitrogenous principles.* As the subject is one of great interest and practical importance, we place before our readers the following table, which shows at a glance the relative proportion of sanguigenous and respiratory principles in some of the more common articles of food. The contents of this table form a portion of a more extended one in Liebig's *Familiar Letters on Chemistry*, (p. 361,) with the exception of the three last items, which are given on the authority of Professor Christison:—

	Nitrogenous.	Non-nitrogenous—as starch.
Cow's milk, . . .	10.	30.
Horse beans, . . .	10.	22.
Peas, ...	10.	23.
Wheat flour, . . .	10.	46.
Oatmeal, . . .	10.	50.
Barley, . . .	10.	57.
Potatoes (white) . .	10.	86.
Potatoes (blue) . .	10.	115.
Rice, ...	10.	123.
Carrots, . . .	1.5 per cent.	8.5 per cent.
Turnips, . . .	0.3 "	5.7 "
Cabbage, . . .	0.3 "	6.7 "

The diseases produced by an *excessive* proportion of nitrogenous matters in the food are identical with those resulting from an excessive quantity of food. Diseases so induced are, however, extremely rare, for, in the country at all events, the food of cattle

* LIEBIG'S *Letters*, p. 361.

seldom contains an excess of flesh-producing principles. A *deficient* quantity of these is, however, very common, and there is certainly no form of insufficient food so frequent. Indeed, cattle are not so often starved from the deficient quantity of food as from its deficient nutritiveness, caused by its containing an insufficient quantity of nitrogenous principles. But food deficient in these flesh-producing principles has exactly the same injurious effects upon the health as when deficient in absolute quantity. The ultimate effect is the same in either case, for in both the supply is inadequate to the demand. On this subject, however, we have already dwelt at considerable length, and shall only remark, in conclusion, that food, when deficient, whether from insufficient quantity or insufficient nutritiveness, produces these common effects. It retards the growth of the young animal, prevents the accumulation of fat in the older one, and arrests the secretion of milk in the cow, thus leading to great loss of butcher-meat and dairy produce; it causes exhaustion of strength and depression of the organic functions, and predisposes to many diseases, by depriving the animal of the power of resisting their exciting causes. Whatever, then, may be the ultimate destination of an animal, it should, if possible, be kept in a state of continuous improvement from birth onwards. Its growth should never be allowed to stand still, much less to retrograde, else the health of the animal will be deteriorated, and the profit of the proprietor materially decreased.

3. *The advantages of a variety of food, and of a due preparation of it.*—In the feeding of domesticated animals, it is of great importance to vary the form in which the food is given. All animals instinctively prefer variety in their diet, and thrive best when such variety is provided. In the dietaries of prisons, workhouses, and other public institutions, the importance of this principle is acknowledged and acted upon. Professor Thomson's experiments on the food of cattle also show similar results, especially in the case of milk cows. He observed that every change in the food caused at first an increased secretion of milk; and this continued for a short time, even although the new food was inferior to that previously used, and although, after a time, such food caused a material diminution of the quantity of milk yielded. "It will be found," says Dr Thomson, "that a change of food produces an increase in the quantity of milk, and that, after the same diet has been continued for some days, the milk begins to diminish in amount." * A farther evidence in favour of variety in the feeding of animals is shown in tho superiority of old as compared with recent pastures—for this superiority is believed to consist in the greater variety of grasses found in old natural pastures. Again, it is well known that both cattle and sheep thrive best when their pasturages are frequently changed—another evidence in support of the utility of variety of food.

* THOMSON *On the Food of Animals*, p. 141.

In making these changes in the diet of cattle care must, however, be taken that they be not of so sudden and violent a nature as to cause derangement of the digestive organs. Indigestion and hoven are often produced in cattle by their eating food of a different nature, or in a different condition, from that to which they have been accustomed, and such effects are often caused by very small quantities of the strange food. A few mouthfuls of wet clover or tares are often sufficient to paralyse the functions of digestion, and cause the food to pass into a state of chemical decomposition, thus inducing serious and sometimes fatal distension. Such cases would seem to warrant the inference that the stomach requires some time to adapt itself to the proper digestion of strange food, this adaptation probably consisting in a slight modification of the gastric secretions.

The health and improvement of cattle greatly depends on the judicious *preparation of their food.* It ought always to be in a condition in which it can be easily and speedily digested and assimilated. To effect this purpose roots should be sliced, straw and grass cut or chopped, and grains bruised. The great advantages of such processes are observable in all the domesticated animals, and are now generally adopted in the feeding of horses. A very convincing proof of the utility of the fine division of food, in the feeding of milk cows, is given by Dr Thomson. He fed two cows, for five days, on *entire* barley and grass, and for other five days on *entire* malt and grass. He then gave for five days the same quantity of barley he had previously given, but in a *crushed* instead of an entire state; and lastly, for five days more, the same quantity of malt as before, but *crushed.* The result of the experiment was very decisive. During the latter ten days—that is, when receiving the crushed food—both animals yielded a considerably larger quantity of milk than they had done during the previous ten days, when getting the same food without being crushed.

The cooking and steaming of food is another important means of rendering it more easily and thoroughly digested and assimilated. Food, so prepared and mixed, as it invariably ought to be, with a sufficiency of salt, is very palatable both to cattle and sheep. It should be given while hot, as in this state it prevents the loss of that amount of animal heat which would otherwise be expended in raising the cold food to the temperature of the body. For milk cows, food so prepared is especially useful in stimulating a copious secretion of well-tasted milk, and keeping the digestive organs, and indeed the whole system, in good order.

4. *The proper regulation of the times of feeding.*—Amongst the lower animals, not less than with man himself, regularity in the *times* of feeding is of great importance. Cattle, if fed regularly, soon learn to know the exact times at which their food should be given them; and if they do not get it at the regular

time, they become restless and uneasy. When this is of frequent occurrence, it prevents improvement in condition, or the yielding of the usual amount of milk. Cattle in stalls or courts should be fed three or four times a-day, and, in the intervals between meals, be allowed as much chopped straw as they can eat. But, while care must be taken that cattle are fed sufficiently often, the opposite error of feeding them too often must also be avoided, since, by such a practice, the animals are too frequently disturbed, and have not enough of rest and quiet, so essential to speedy fattening. In the management of the carnivora, a very different system of feeding is adopted. Their food is less bulky and more highly nutritive than that of herbivora, and their habits lead them to consume it in proportionally larger quantities at a time, but at longer intervals. Many of these animals are in better health when getting only one meal a-day, than two or more. For instance, when the leopards and hyenas in the Royal Zoological Gardens of London received their food, as they did for some time, twice in the twenty-four hours, it was observed that they fell off in condition, their tempers became more irritable, and they were less inclined to take their usual amount of exercise, so that it became necessary before long to return to one meal per day. The rule of giving a single meal a-day is also adopted with many fox-hounds, pointers, and other sporting dogs, especially when getting animal food.

I am not aware that irregularity in the times of feeding is actually productive of disease. Its principal effect is the retarding of growth; and this is often very remarkable, particularly in young animals, which suffer more frequently than older cattle from this and many other sorts of neglect.

I have now noticed the more important points to be attended to in a proper system of diet, and have also noticed the evils of insufficient and bad feeding. I have endeavoured to show that food should be duly regulated as to quantity, as to nutritiveness, as to proper proportions of flesh-producing and heat-producing elements, and variety, to facilitate digestion and assimilation, and, lastly, as to the times of feeding. These appear to me the chief requisites of a good system of diet, and a strict attention to them cannot be otherwise than highly conducive to the successful and economical management of stock.

II. I now come to the second section of this paper—namely, the sheltering of cattle and sheep. I shall divide it into these three heads—Rain, Cold, and Shelter—and conclude with a few observations on the drainage of the soil, confining my remarks to the influence of these climatic elements on the sanitary condition of cattle and sheep.

1. *Rain.*—The injurious consequences of exposure to wet result from the moisture itself, and in great part from the cold which, in a climate such as ours, almost invariably accompanies it. The in-

halation, for any great length of time, of an atmosphere surcharged with moisture, cannot but exercise a deleterious influence on the animal body; for such an atmosphere contains, in proportion to its volume, less oxygen than drier air, and possesses a power of diffusion considerably inferior to it. This diminished power of diffusion interferes with the full and rapid arterialisation of the blood—a process on the due activity of which depend life and health. Further, moisture promotes decomposition, and facilitates the transmission of infectious disorders. When conjoined with undue warmth, it has a powerfully relaxing effect, and thus renders the body more susceptible to the exciting causes of disease. But when it occurs in connection with cold, dampness produces its most frequent and serious evils, its power becoming then increased tenfold. It abstracts heat and electricity from the body; interferes with the important functions of assimilation and secretion; and thus gives rise to abnormal changes of the blood, to the retention of effete particles, and to the imperfect renovation of the plasma.

Exposure to rain generally occurs in connection with other errors in management, such as exposure to cold and want of drainage; and hence it is somewhat difficult to separate its effects from those of other existing circumstances. It cannot, however, be doubted that continued exposure to rain is exceedingly prejudicial to the wellbeing of animals. Its most uniform effects are a tendency to diarrhœa and muscular relaxation. It generally interferes with the natural functions of the skin, arresting its exhalations, and so leading to an excess of the fluid parts of the blood. This is well shown in the marked tendency to anasarca and œdematous swellings, as observed among men and animals living in moist localities. Dampness of the atmosphere, as caused by continued rain, favours the development of lice and other insects, which often appear after the rain has passed away, especially if it is succeeded by warmth. Wet weather is very apt to induce rheumatic enlargements of the joints, foul in the feet, and not unfrequently quarter-ill. During such weather, an unusually large amount of moisture is contained in the pasture and other green fodder. Food in this condition is apt to give rise to indigestion, or, passing into a state of chemical decomposition, it may cause evolution of gas and distension of the rumen. When such food is kept even for a very short time, it is apt to undergo chemical change, and sometimes acquires unusual acridity; and in this state it causes diarrhœa, irritation of the kidneys, and sometimes red-water.

But however inimical exposure to rain may be to the health of neat cattle, it is much more so to sheep. In them, it is apt to cause diarrhœa, affections of the feet, enlargement of the joints, scab, braxy, and rot—one of the most serious and fatal of the diseases incident to sheep. Besides, continued rain also interferes with the thriving both of cattle and sheep; and it is well known that rainy seasons are bad seasons for the grazier.

2. *Cold.*—There are few agents in a climate such as this more active in the production of disease, either among men or animals, than exposure to cold. A low temperature, however, unless accompanied by moisture, does not seem to be injurious to animals in good health, and abundantly supplied with food; and if ordinary causes of disease or debility be carefully guarded against, cattle and sheep seldom suffer from exposure even to a very great degree of cold. But though animals placed in such circumstances may enjoy good health, still they cannot be expected to arrive at an early maturity, to yield a large supply of milk, or speedily to accumulate fat. On the contrary, there are few circumstances more opposed to the rapid growth of an animal, or its speedy preparation for the butcher, than extreme cold. It necessitates the consumption of a very large quantity of food, in order to replace the animal heat of which the body is deprived by the low temperature of the surrounding medium. But, besides the absolute coldness of the air, there is another point requiring consideration, as indicating the necessity of a most ample supply of food—and that is, the augmented density of the air, the necessary consequence of its low temperature. On account of this increased density, a given volume of air contains a larger quantity of oxygen; and this, entering the body by the lungs, causes a more rapid combustion, and requires therefore a larger quantity of combustible matter with which to combine. Thus, exposure to cold retards the improvement of an animal's condition, and increases the amount of food required to keep it in health, in these two ways: 1st, by the absolute amount of heat abstracted by the external cold; and, 2d, by the more rapid and complete consumption of the calefacient elements of the food, owing to the larger quantity of oxygen contained in every volume of the cold, and consequently dense, air which the animal inspires.

Exposure to a moderate amount of cold, and for a limited time, increases the vital energies, and invigorates the organic functions. But if the exposure is carried to excess, and continued for a length of time, it has an exactly opposite effect. It exercises a sedative or depressing influence, inducing slowness of the circulation, obstruction of the capillary vessels—especially of those parts most exposed—feebleness of the respiratory process, diminished power of generating heat, muscular rigidity, blunted perception, coma, and death. These are the symptoms which manifest themselves in animals exposed to such a degree of cold as speedily to produce the fatal effects sometimes seen in all stages of development and degrees of intensity, during severe winters, by shepherds whose pasture-grounds are unsheltered, and exposed to piercing cold and scourging winds.

The production of disease by cold depends chiefly on its sedative effect, and on the reaction which succeeds that effect; or, in other words, it depends on the irregular distribution of the blood, and

on the consequent endeavours which nature makes to restore the lost balance of the circulation. In producing disease, cold operates somewhat as follows: It causes contraction of the arteries and capillaries in those tissues over which it exercises its influence; and when the whole body is exposed, it is the arteries and capillaries of the skin and other external parts which are most affected. This diminution of the calibre of these vessels prevents the free circulation of the blood through them, and hence the fluid is sent in an unusually large quantity through the internal organs which thus become congested, their functions becoming also impaired, and their secretions and excretions arrested. This, by augmenting the irritation consequent on the large volume of blood passing through these internal organs, induces a still greater determination of blood towards them, and thus congestion passes into inflammation. Such is the manner in which external cold induces internal inflammation.

The exposure of cattle and sheep to a cold dry air, and especially if it be in a state of constant agitation from winds and currents, seems to modify the type or character of disease—increasing particularly the liability to affections of the serous and fibro-serous membranes. Thus in clear, cold, and windy weather, pleuritic attacks are more frequent than in opposite states of the atmosphere; and farther, during weather favourable to the production of pleurisy, all pulmonary affections are apt to show symptoms which clearly prove that the pleura has become involved in inflammation which may have been previously confined to the mucous lining of the bronchii and air-cells, or to the parenchymatous tissue of the lungs. The pleuro-pneumonia epizootic, as at present prevailing among cattle, affords frequent examples of this fact; for when that disease occurs in animals in cold and exposed localities, and especially during severe and boisterous weather, the inflammation of the pleura almost invariably predominates over that of the other pulmonary tissues. During such weather, too, the other serous and fibro-serous tissues are also particularly susceptible of inflammatory attacks. Rheumatism, in which these and other tissues of comparatively low organisation and vascularity are almost exclusively affected, is of frequent occurrence; and diseases in general are apt to assume an acute or inflammatory type, and seem also to bear antiphlogistic remedies bettor than usual.

But besides these diseases, cold, in combination with other causes, and in predisposed subjects, gives rise to the most varied and opposite effects. It predisposes to inflammation of the viscera of the cranium, the thorax, and the abdomen. It produces internal congestions, and occasionally gives rise to dropsies and hemorrhages. It favours the production of mammitis, and sometimes occasions spasmodic and neuralgic diseases. By arresting their secretions, it produces irritation of the skin and mucous

membranes. In cows, the quantity of milk becomes much diminished. The bowels are not generally affected; occasionally, however, constipation is induced, and sometimes diarrhœa, especially in animals predisposed to it.

In conclusion, we would remark that exposure to cold is inconsistent with the sound management of stock, inasmuch as it causes an unusually rapid waste of the food consumed, and thus prevents its being applied to the increase of growth, to the accumulation of fat, or to the secretion of milk. When combined with certain morbific causes, it becomes a fertile source of disease, acting sometimes as a predisposing, and sometimes as an exciting cause. The affections, however, most frequently arising from it are such as generally owe their immediate development to derangement of the circulation.

3. *Shelter.*—Want of shelter is injurious both to plants and animals. It exposes them to sudden and excessive changes of temperature, and to the heat-abstracting influence of cold, of winds, storms, rain, snow, and fogs. Its fatal influence on vegetation is well shown in one of Mr Bain's very valuable series of papers on shelter, which have appeared from time to time in the *Journal of Agriculture.* He there proves, beyond doubt, that the bleak country, the stunted trees and fences, and the thin short miserable crops, which even in this age of improvement still meet the traveller's eye in many parts of the United Kingdom, are for the most part the unmistakable evidences of insufficient shelter. On the other hand, Mr Bain shows that, even with an ungrateful soil, and in unfavourable circumstances, judicious shelter often produces rich and luxuriant crops, where, "but for the shelter, nothing whatever would have grown." *

But the want of shelter entails evil consequences not only on plants, but also on animals, increasing very materially the cost of their livelihood, retarding their growth, and rendering them liable to many serious diseases.

Exposure to cold, as above stated, necessitates the consumption of a very large allowance of food; and when, as is usually the case with animals badly sheltered, such exposure to cold is conjoined with exposure to rain, and to all sorts of weather, the necessity for an increased supply of food will be still greater. In such circumstances, an unusually large quantity of material is expended in the maintenance of the animal heat; and if this extra expenditure be not compensated for by an increased quantity of food, the animal necessarily loses weight,—or, in other words, the fat which it may have previously accumulated is reabsorbed, entering into chemical combination with the oxygen in the systemic capillaries, and by this combination evolving the heat required to replace that abstracted by exposure to the inclemency of the weather.

* *Journal of Agriculture,* Oct. 1851, p. 170.

The beneficial effects of shelter in feeding are well shown in an experiment made at Whitfield, by Lord Ducie, some years ago. A flock of two hundred sheep was divided into two lots of a hundred each. One of these lots was placed in sheds, and being allowed an unlimited supply of Swedish turnips, it was found that each animal consumed on an average 21 lb. per day. The other lot remained in the open air, and without shelter, and, although getting the same sort of turnips, each sheep consumed 25 lb per day. After being thus managed for some months, the sheltered sheep were found to weigh, on an average, 3 lb a-head more than those kept in the open air, although the latter had consumed nearly one-fifth more of food.* Hence it is clear that the amplest supply of food, without sufficient shelter, is inadequate to impart a high condition to animals.

The general appearance of animals living in badly-sheltered houses or localities is unthriving: the skin is hard, dry, and inflexible; and the hair rough, and stands on end. They are frequently affected by a *hoose*, or cough, which is obstinate and difficult to get rid of. It is generally loud, clear, and distinct, and of a sort which people are in the habit of calling healthy. It is certainly not the worst sort of cough, and it does not, perhaps, indicate any immediately fatal disease; but it is a cough, and, as such, it is a symptom, and an indubitable one too, of some irritation of the pulmonary mucous membrane—an irritation probably caused, in such a case as this, by sudden variations in the temperature of the atmosphere.

Amongst the diseases to which insufficient shelter more particularly gives rise, are those affecting the respiratory organs—organs which, from their susceptibility, and their relation to the external air, are particularly liable to suffer from any change in the temperature, moisture, or other conditions of the atmosphere. Catarrhs or runnings at the nose are occasionally met with, but these are much more common in man and in the horse than among cattle and sheep. In these ruminants, exposure generally involves the mucous lining of the bronchii or of the lungs, producing irritation, congestion, and, in aggravated cases, inflammation. In cases of bronchitis, pneumonia, or pleurisy, resulting from insufficient shelter, the inflammation generally involves in a greater or less degree all parts of the respiratory system; but the whole extent of the mucous membrane, from the larynx downwards, seems especially to participate in the disease. In such cases, death usually results from the ingress of the air being prevented by the effusion speedily filling up the various ramifications of the bronchial tubes. It is this form of inflammation of the lungs which generally cuts off animals brought from a warm to a colder climate. In exposed localities, enteritis is often

* *Journal of Agriculture*, Oct. 1843, p. 171.

met with, both among sheep and cattle: many animals suffer from palsy; and inflammation of the eyes and cataract are of frequent occurrence.

In milk cows, and ewes giving suck, the udder is particularly liable to suffer; for in them the mucous membrane of the viscus is in a highly vascular condition, and therefore particularly predisposed to take on inflammation. The injudicious exposure of cows to inclemency of weather, during or immediately after parturition, is one of the most common causes of that form of inflammation of the peritoneum, and the membranes of the uterus, properly called puerperal fever. But of all diseases to which insufficient shelter gives rise, rheumatism is perhaps the most frequent. The manner in which it is produced is somewhat as follows: The insufficient shelter, whether depending on the bad construction of houses or sheds, or on the bleak and unprotected state of the pasturages, exposes the animals to currents of air or winds; these cause derangement of the circulation; and the blood, being driven from the cutaneous and more external vessels, accumulates round the internal organs, and thus causes congestion of the serous, fibro-serous, and cartilaginous tissues. If the immediate or exciting cause of the rheumatism be sufficiently powerful, and the parts in a state of predisposition, as they generally are in animals exposed to the evils of insufficient shelter, the congestion passes into inflammation—and we have the pleura, the pericardium, synovial bursæ, fascia of muscles, coverings of the nerves, lining membranes of the blood-vessels, and cartilaginous tissues of the joints, all involved to a greater or less degree in that specific inflammation termed the rheumatic.

Insufficient shelter, especially if associated, as it too often is, with an indifferent and insufficient diet, forms one of the most fertile sources of phthisis pulmonalis, or pulmonary consumption. The slightest taint of this disease, when nurtured under the favouring influence of insufficient shelter, obtains a firm hold on the constitution, and, gradually gathering force, runs a rapid and fatal course. The disease, however, occasionally springs up independently of any apparent predisposition, seeming capable of being induced by the influence of insufficient shelter alone. In such circumstances, insufficient shelter acts in a manner analogous to other debilitating causes. It depresses the vital energies, interferes with the processes of assimilation and secretion, and in extreme cases gradually produces that degeneration in the vital fluids which leads to the deposition of tubercular matter in various parts of the body.

Another and very common affection, in exposed localities, is the growth of scrofulous tumours—most generally appearing about the head and neck. These most usually affect young animals, causing much pain—which, however, is more acutely felt in the parts contiguous to the swelling, than in the swelling itself.

They belong to the class of malignant tumours, generally run on to softening, and are often very difficult of cure.

Besides these diseases, want of shelter also gives rise to various accidents, which, in certain localities, are even more serious than disease, and often lead to greater loss. We refer particularly to the large number of lambs and ewes which, in many cold and naturally unsheltered parts of the country, annually perish during the lambing season. By some the loss of the lambs has been estimated at 20 per cent, and that of the ewes at about 6 or 8. Although this estimate, as applied to most hill-farms, and even to Scotland, is perhaps considerably above the average, still it cannot be doubted that the annual loss of life during the lambing season is, in such situations, very great, and that it is mostly to be ascribed to want of shelter. Since such is the detriment to health, such the loss of life and of capital, which result from insufficient shelter, surely more attention should be bestowed upon the means of remedying this evil. The measures to be employed for this end are in themselves few and simple; but the putting of them into practice is sometimes attended with considerable difficulty. They may be briefly stated as follows: Let the situation selected for the erection of the habitations of animals be naturally well sheltered, especially from the prevailing winds of the locality, either by surrounding eminences, by strips of plantation, or by buildings. Let the construction of the houses be such as to insure the highest possible degree of health to the animals which are to inhabit them. The efficient sheltering of pasture and sheep grounds is a point of much importance, but one of considerable difficulty. Natural shelters—such as hills, woods, &c.—must be taken advantage of; and high grounds should be covered by plantations, as affording shelter to considerable distances. The judicious planting of trees, sometimes in rows and sometimes in clumps, is a very valuable mode of sheltering fields; and the laying down of hedgerows, and even the building of properly-constructed walls, often aid materially in securing cattle and sheep from the inclemency of the weather.*

* Mr Bain, who has for several years been well known to agriculturists as an able and persevering advocate of "shelter," thus states its great importance as an agricultural improvement: "I am at last so satisfied with the value and necessity of shelter over the larger portion of these kingdoms, that, instead of pleading for it as profitable, and a great auxiliary to improvement, I am inclined to state it to be *a necessary and indispensable preliminary to all improvement*, at least if we would have it *duly profitable*. There is no doubt that, by draining and cultivating and manuring, we may greatly improve the land, and the amount and quality of its crops; and there is no doubt that by these means we *have* immensely improved both; but judicious shelter, where necessary, would immensely farther have improved both the land and the crops, whether these last should be of grain, or of vegetables, or pasture, and also in like proportion have furthered the comfort, and the health, and the growth of the animals fed upon them, whether in the fields or in the stall."—*Journal of Agriculture*, Oct. 1851, p. 166, 167.

4. *Drainage of the soil.*—Want of drainage contributes largely to the humidity both of the soil and of the atmosphere. An excess of moisture in the soil renders it more difficult of cultivation, and both lessens the quantity and deteriorates the quality of its produce. The gradual evaporation of moisture diminishes greatly the temperature of the soil; and hence the difference in temperature between an undrained and a well-drained soil is often 10° or even 15° Fahr. This great difference depends on the great abstraction of heat necessary to convert water into vapour; and it is calculated that 1 lb. of water evaporated from 1000 lb. of soil will depress the temperature of the whole 10° Fahr. The constant evaporation taking place from a damp soil necessarily causes a damp atmosphere, which retards both vegetable and animal growth, facilitates decomposition of all organic substances, and interferes with the due performance of the vital functions. These effects of a moist atmosphere result principally from its low temperature; but its property of abstracting electricity, its limited power of diffusion, and its general relaxing influence, tend farther to render it injurious to animal health.

Insufficient drainage existing over considerable tracts of country deteriorates the climate of these districts, and that in no small degree; whilst an efficient system of drainage, extensively adopted, ameliorates materially the climate of a locality, raising considerably its mean annual temperature, and lowering in still greater proportion its position in the hygrometrical scale. Further, to the improved drainage and cultivation of the soil of this country we may doubtless ascribe the amelioration which its climate seems to have undergone even within the last fifty years. Our winters are now of shorter duration, and less severe than those which were common towards the close of the last, or even during the beginning of the present century. We have not now the long-continued frosts, the tremendous snow-storms, or the deluging rains, which were then of common occurrence. Our harvests are earlier, and we have now less apprehension of our crops being spoiled when ready for the stack-yard. We can now grow large quantities of wheat on soil which previously produced only meagre crops of barley or of oats. Leicester sheep are successfully reared where less valuable breeds could formerly be scarcely brought to perfection; and in many districts the improved short-horned cattle have replaced coarser indigenous varieties. Fevers, agues, and dysenteries among men, the so-called catarrhal epidemics in the horse, and rheumatism, red-water, and rot among cattle and sheep, are now far less common than heretofore. The diminished frequency and severity of these diseases add much weight to what has been above adduced in favour of the belief that a gradual climatic improvement has attended the introduction of agricultural improvements, and especially of

that greatest of all improvements—thorough drainage of the soil.*

But while the ameliorating influence of an improved agriculture has been thus progressing generally throughout the whole country, the same influence is still more remarkable in its beneficial effects in certain localities or districts. The statistics of such localities show, in many instances, a most notable improvement to have taken place even within the memory of men still living. It has farther been observed, that such improvements in local climate have invariably kept pace with the condition of agriculture—that they have been arrested while it slumbered, and that they have advanced most rapidly where its progress has been most marked and speedy. If, then, a general improvement in climate is the result of an efficient system of drainage, the defective drainage of a country or locality must necessarily entail upon it a state of climate much inferior to what might be expected from its natural capabilities.

The injurious consequences of insufficient drainage on the health of animals do not materially differ from those we have previously described as occurring in connection with exposure to rain or cold. It induces rheumatism, and especially chronic rheumatism, affections of the joints, foul of the feet, and that indurated condition of the udder which indicates chronic inflammation of the parenchyma of the viscus—a condition especially apt to affect cows turned out to undrained pastures when their milk has become dried up. In damp undrained localities, swellings and ulcerations of the eyelids, ill-conditioned states of the skin, diarrhœa, dysentery, and peritonitis, both common and puerperal, are all of frequent occurrence. It is in such circumstances, too, that we generally meet with that species of bronchitis affecting particularly young stock and calves, caused by the presence in the bronchii of myriads of minute filaria. From want of proper drainage, pasturages are often very coarse, and produce plants more or less injurious to health, and which, if eaten, may cause intestinal derangements and red-water. In ill-drained districts, too, diseases of all sorts are apt to assume unfavourable types; inflammations and fevers, usually acute, lapse into the typhoid state, while unhealthy cachexiæ and pulmonary consumption are not uncommon. Animals indigenous to such localities often have a general unhealthy appearance, are of a lymphatic temperament, deficient in vigour, and are longer in coming to maturity than those reared in more favourable circumstances.

* The beneficial effects of agricultural improvements, and especially of drainage, are thus described by a French veterinary writer: "L'homme modifie le climat qu'il habite en faisant disparaître les forêts, en desséchant de vastes localités, ou en dirigeant de grandes irrigations. La culture seule suffit pour changer la température. Elle est moins froide au nord de l'Amérique, depuis que la charrue s'y est établie." — GROGNIER, *Cours d'Hygiène Véterinaire*, p. 71. Paris: 1837. Another French author, M. Magne, speaking of drainage, remarks: "Il n'est moins intéressant sous les rapports de l'hygiène que de l'agriculture."

Among sheep we find similar diseases prevailing; such as rheumatism—both chronic and acute—paralysis, foot-rot, typhoid fevers, braxy, diarrhœa, enteritis, and rot. The last of these is often exceedingly fatal, especially where, in addition to the insufficient drainage, the country is rich and flat, and where the pasturages are liable to be flooded.

ON CLOVERS AND GRASSES BEST SUITED FOR TWO OR THREE YEARS' PASTURE.

By Mr James Black, Factor, Ellon, Aberdeenshire.

[Premium—The Gold Medal.]

Of the value of pasture to the agriculturist there can be no doubt. It forms the staple food of stock during a great proportion of the year, and on that account alone its importance demands, from those interested in its cultivation, spirited efforts and judicious experiments towards its improvement. The principal drawback throughout the country generally, to enlightened modes of operation in this respect, is the want of confidence in the results. By forming, however, accurate estimates, physiologically, of the nature and qualities of the various kinds of grasses, much of this disinclination might be overcome, and a more enlarged experience would doubtless give rise to many valuable practical suggestions.

In submitting the following report of my experience in selecting and cultivating various kinds of clovers and grasses, in order to obtain for .two or three years the greatest amount of pasture, I was led primarily to inquire what those properties were which, in this view, constituted their value. The conclusions arrived at were—first, early spring and late autumn growth; second, productiveness and nutritiveness before and after being cut or pastured; and, third, the readiness with which seeds might be obtained and the grasses propagated. Setting out with these points as first and ultimate principles, experiments were made in 1846 and 1847, under my personal observation and direction, with twelve varieties of the most approved grasses, either suitable for the alternate husbandry or permanent pasture, with the view of discriminating the best and most valuable, and as preparatory to other experiments on a broader and more extensive scale.

On the 20th April 1846, those grasses which will afterwards be enumerated were sown. But, in order that they might have the same justice done them as is to be expected in ordinary cultivation, and that the comparative product of each variety might be calculated as accurately as possible, an allotment of a square yard of ground to each species was given. The soil was sandy, though tolerably rich, but possessed no peculiar advantages of situation. The progress of the growth of the plants was particularly noted,

as well as the time at which they arrived at maturity, with as nearly as possible an estimate of the quantity of seeds produced. The various lots were then cut, and the weight with the relative product of each ascertained. The after-crop was treated exactly in a similar way: particulars of growth, weight after being cut, and comparative values, were all ascertained as minutely as possible.

My principal reason for adopting this procedure was to ascertain, as far as practicable, the most valuable of those grasses experimented with, and to compare my own results and conclusions with authorities on the subject, before beginning to make the larger experiment. That much dependence can be placed on such experiments, however accurately conducted, is not asserted; but, being interesting and instructive, they serve an important purpose if they should tend to form, in the slightest degree, correct notions about the grasses most suitable for two or three years' pasture. I consider it unnecessary, therefore, to enter minutely into detail respecting the result of the experiment on these grasses, and am content to submit such remarks on each variety, founded on personal knowledge and experience, as in my opinion may be found useful.

1. *Alopecurus pratensis*—Meadow foxtail-grass. This grass, which was sown with great care on account of the lightness of the seed, came up early, but not very thickly or luxuriantly. In consequence, however, of its not flowering, or, as is generally known, arriving at perfection till the third or fourth year after being sown, and from the difficulty thus experienced in procuring seeds readily and cheaply—together with the peculiar objections to the sowing and bedding of the seeds, arising from their lightness, and the consequent uncertainty of the produce—I am decidedly of opinion that these circumstances render it unsuitable for two or three years' pasture. Facility in depositing the seed, sure and early vegetation, rapidity and closeness of growth, under the greatest variety of circumstances, are important and necessary points to be aimed at, because essential to the interest of the practical man. The produce of meadow foxtail, compared with *Lolium perenne*, (perennial rye-grass,) is as 5 to 9.

2. *Cynosurus cristatus*—Crested dogstail-grass. I have frequently observed that this grass has a wide range of natural situation; that it grows with great luxuriance on moist soils of considerable depth, and on soils that are light and dry; and that on almost every variety and condition of soil it is to be met with, exhibiting proofs of its merits as a hardy productive native grass. On this account mainly I was induced to give it a place in these experiments, to test whether it had those properties which might render it valuable as a proportion in a mixture of grasses for two or three years' pasture. In this respect I was not disappointed, and

am therefore compelled to differ slightly from those who consider it merely fit as a permanent grass. Having sown it somewhat thin it came up scantily, but in the succeeding season it matted very close; and although the herbage was not tall, yet it continued in such profusion throughout, and till late in the season, that I had no doubt of its value, and accordingly introduced it as a component grass in the larger experiment. It has been asserted that the culms of this grass, when allowed to run to seed, are not eaten by cattle; but this is an objection that applies more or less to every species of grass. That it is productive of an abundance of nutritious root leaves, which are relished and eaten with avidity by cattle and sheep, is the best proof of its value as a pasture grass, and ought of itself to substantiate its claim to that position. But its importance in a season of severe drought ought to form an additional reason. For instance, along the uncultivated margins of streams, and on verdant banks, where generally the herbage is exceedingly rich and close, this grass is found in large proportion, penetrating the earth with its roots to a considerable depth; and thus in a droughty season, as it continues to abstract moisture from the soil, it retains its verdure, when other and perhaps more valuable plants, of a different habit of growth, have been completely scorched and dried up. My opinion of it, therefore, is a decidedly favourable one, in regard to its being used as a grass for the alternate husbandry. Its product, as compared with *Lolium perenne*, is as 13 to 18. It flowered about the end of June, and ripened its seeds towards the end of July. The seed produce was pretty considerable; but as the culms generally are not so numerous as those of *Lolium perenne*, the cost of the seeds would always run proportionably high.

3. *Dactylis glomerata*—Rough cocksfoot-grass. This grass came up with remarkable luxuriance, and continued rapidly to grow during each consecutive season. It exhibited during the second year great profusion of herbage, and arrived at maturity in August. When compared with *Lolium perenne*, its produce was found superior to that grass in the ratio of 14 to 9. As it seeds abundantly, these could be procured in any season readily and cheaply. Considering its extraordinary rapidity of growth and profusion of herbage, one would be inclined, without hesitation, to give it a place as a grass eminently suited as a proportion in a mixture for the alternate husbandry; but when it is found left untouched by cattle—very often in the early part, but particularly towards the close of the season—on account of its roughness, it may in this sense be objected to. I am inclined to give due weight to this objection, notwithstanding that Mr Sinclair and others have given this grass a high recommendation. So far as my own observation enables me to judge, I have never found horses or cattle very fond of it at any time. That they

reject its strong and hard culms, when allowed to grow up, is an objection that applies to this grass in common with some of our best species; but its large bushy mass of root leaves are rough and coarse, and only appear to be eaten in the absence of more palatable and succulent herbage. On this account, I always use it in small proportion; but do not consider it ought to be excluded, under certain circumstances, from forming part of a mixture of grasses for two or three years' pasture.

4. *Festuca duriuscula*—Hard fescue-grass. This is a very early grass, and undoubtedly valuable for alternate cultivation. It has the important properties of growing abundantly on almost every variety of soil, and of standing drought well. Another most important feature in its favour is, the avidity and relish with which it is eaten by cattle of every description. As it is a perennial, and indigenous to this country, it will be found very valuable, along with other grasses (which will be pointed out afterwards,) in the second and third years' pasture, as the rye-grass and clover disappear, by affording in their place an abundant and nourishing herbage. The satisfactory appearance of this grass throughout the season, together with the impressions previously formed from personal observation of its properties, as suited particularly for remaining in the ground when other varieties fail, led me to introduce it as part of a mixture for two or three years' pasture. Its produce, when ripe, compared with *Lolium perenne*, is nearly equal; but its value consists more in affording certain pasture, when other kinds fail or die out. It flowers towards the end of June, and the seeds arrive at maturity in tolerable abundance in the latter end of July.

5. *Festuca pratensis*—Meadow fescue-grass. This grass came up uniformly and luxuriantly. In the season following it flowered towards the end of June, and gave a large bulk of produce for hay, nearly equal in proportion to *Lolium perenne*. Having observed the preference given to this grass by cattle, generally on account of its excellent, remarkably succulent, and tender herbage, I was prepossessed in its favour, and disposed to coincide with the favourable opinions scientific agriculturists have formed of its qualities. There can be no doubt, however, that it should be sown only on rich and somewhat moist soils, in order that its productive powers may be fully developed.

6. *Lolium Italicum*—Italian rye-grass. In regard to extraordinary herbage, perhaps of all the known cultivated grasses the *Lolium Italicum*, for the first season, is undoubtedly the best. In the experiment made upon it along with the other grasses, it far outstript them all in the abundance of herbage it produced. It was sown with the others on the 20th April, and of course along with them had, in regard to season, similar advantages and disadvantages. But its return was pre-eminently superior. On

the 13th June, in the season succeeding its being sown, it was cut in full flower; and when compared with the produce of *Lolium perenne*, at a similar stage of growth, was superior in proportion as 14 to 9. Again, on 1st September it was cut nearly in a ripened state, and proportionately was as 12 to 9 compared with the previously-estimated produce of *Lolium perenne.* On 20th October it was again cut, the culms being merely in an embryo state, when it weighed 12 ounces. The aggregate produce therefore, when compared with *Lolium perenne*, was as 16 to 7. That this grass should be considered by scientific agriculturists as a decidedly important acquisition to the number already considered useful is not to be wondered at, when we look at its return even in this case; but otherwise, knowing its capabilities, we may further remark, without risk of exaggeration, that in the hands of a successful cultivator, who thoroughly understands the physiology of its vegetation or its peculiar adaptation to any particular condition of soil, a yet more extraordinary and profitable return may be expected. During the season of 1848 it showed an exuberance of herbage equal to that of the other grasses, but not equal, however, to its own produce in the season preceding. The seeds I had were imported direct from Germany by a seedsman in Aberdeen; and notwithstanding the opinions expressed in various quarters, of the annual nature of the grass, I am disposed to consider that, when genuine, and sown on good soil in a favourable situation, it will brave the severity of winter, and exhibit early in spring and throughout the whole season its accustomed vivacity of growth.

7. *Lolium perenne*—Perennial rye-grass—(*Pacey's variety.*) The importance of this grass for pasture is so well known and acknowledged by every agriculturist, that it is unnecessary here to allude to it in that sense. As, however, the relative produce of the other varieties experimented upon are calculated on the basis of the produce of this grass, it is important to state particulars respecting this point. According to the idea prevalent throughout the midland and northern counties of Scotland, to have rye-grass cropped about a fortnight previously to its becoming ripe, it appeared sufficiently mature for this purpose on the 28th June, and was cut accordingly, the produce weighing 18 ounces. On the 28th August the after-produce was also cut, and found to weigh 10 ounces.

8. *Lolium perenne*—Perennial rye-grass—(*Russell's variety.*) This grass I do not consider so suitable for pasture as Pacey's variety. I had it from a noted seedsman in England, and believe it to have been genuine. That it produces a greater abundance of hay and seeds than the other variety was proved by the experiment made; but the aftermath was not so profuse, nor the general appearance of the leaves so broad or succulent. I

would not, therefore, for this reason give it the preference; as also because seeds true to name cannot be procured so readily or cheaply as those of Pacey's variety. Besides, the cultivation of perennial rye-grass throughout England, and on the high-farming districts of Scotland, is mainly confined to Pacey's variety, which has now for a long time maintained a deserved celebrity. The produce of hay is as 11 to 9 compared with Pacey's variety. The aftermath as 4 to 5.

9. *Phleum pratense*—Meadow catstail or Timothy-grass. I am not disposed to consider this a very suitable grass for two or three years' pasture. If for the purpose of hay, it is desirable, and has obtained in that respect considerable celebrity both here and in America, where it is very extensively cultivated; but as its leaves are not very much liked either by horses or cattle, and as I found in this case, as well as in my previous experience, that its produce after being cropped was considerably inferior in quality or palatableness, and in quantity, to several others, I concluded, if it formed a constituent in a mixture for two or three years' pasture, on being depastured, that the comparatively immaterial after-produce would, in addition to its other characteristics, render it very unprofitable. It is a very hardy grass, however, and there may be circumstances in which it might be sown judiciously, such as for the protection of other and better relished grasses of a more tender habit. Its produce when ripe, compared with *Lolium perenne*, was as 15 to 9 when cut; afterwards, as 6 to 9. In its natural situations it generally flowers in the end of June, and ripens its seeds towards the end of August.

10. *Poa nemoralis*—Wood meadow-grass. This grass exhibited considerable luxuriance till it arrived at maturity; but, so far as its merits as a pasture grass could be tested by this result, these could not be considered as favourable. In the after-produce there was a large deficiency in quantity, and the same objection may apply to it in this respect as to *Phleum pratense*. It cannot, therefore, be recommended as a constituent grass for two or three years' pasture. It flowered about the end of June, but appeared not to ripen its seeds. It was therefore cut, and its produce when compared with *Lolium perenne* was as 11 to 18, when cut in September; afterwards, as 4 to 9.

11. *Poa pratensis*—Smooth-stalked meadow-grass. The early return this grass gives, and the recommendations it has had on that account, entitle its claims to be investigated. That it presents itself early in spring with considerable foliage, the rich meadows and dry banks throughout the country abundantly testify; but its luxuriance is of short duration, as it ceases generally to be of any use as pasture after the month of June. This was the case in the present instance; and for that reason alone it ought to be excluded from any composite of grasses intended for two or three

years' pasture. The produce compared with *Lolium perenne* was as 6 to 9. The after-return was comparatively insignificant.

12. *Poa trivialis*—Rough-stalked meadow-grass. In the experiment made upon this grass, the result did not nearly come up to the expectations previously formed regarding it. This may have arisen partly from the soil and situation; as I found, on examining the localities where it is to be met with naturally, and in the greatest perfection, that it affected moist and shaded situations. If sown, therefore, in a comparatively dry though rich and sandy soil, as in the case above alluded to, the return could not be expected as profitable, or even favourable. But if the importance and value of this grass is estimated from its already ascertained nutritive properties, from the exuberance of herbage it displays in all seasons in its favourite localities, and from the unquestionable avidity with which it is eaten by cattle of every description—then am I strongly of opinion that it will be found exceedingly suitable as a constituent of a mixture, for a rich moist soil, in the two or three years' pasture, having a low-lying or shaded situation. It flowers towards the end of June, and ripens its seeds in about three weeks afterwards. The seeds are produced in considerable quantity.

In addition to observations made upon these grasses, in the respective patches of ground allotted to them, and also in their several indigenous localities, I practically tested the qualities and merits of *Trifolium hybridum*, (Alsike clover) and *Trifolium pratense perenne*, (perennial red clover, or cow-grass)—the former on the home farm at Ellon Castle in 1847, and the latter on the farm of Charlton, near Montrose, in 1841—and subjoin, on each, the following remarks:—

1. *Trifolium hybridum*—Alsike clover. This clover was used as a proportion in a mixture of grasses for an extent of ground not exceeding two acres. The soil was of a comparatively rich, though light and sandy nature. A quantity of 10 lb. was sown in addition to the ordinary proportions of white clover and perennial rye-grass, and it was with the utmost satisfaction I observed the progress of this new variety. In the succeeding season to that in which it was sown, I tested its merits both for soiling and for pasture. In regard to the former, it yielded, upon the whole, a richer return than the ordinary red clover—the plants springing up much closer, and being equally uniform in growth; and in regard to the latter, I could observe the rich and succulent herbage eaten with the greatest relish by healthy and thriving cattle. I am fully disposed to think that, if this clover could be had cheaper, it would not long continue without being profitably used even by the humblest cultivator. Its present price, however, puts it beyond the reach of ordinary cultivation; and on that account, as I kept it apart from the larger experiment described in the

sequel, I was obliged also to exclude it as a constituent in a mixture of grasses and clovers for two or three years' pasture.

2. *Trifolium pratense perenne*—Perennial red clover, or cow-grass. I have observed that the cultivation of this clover during the last two or three years has been considerably on the increase, and that those parties who have successfully cultivated it once uniformly prefer and use it to the common red clover. It is unquestionably of more permanent growth, and, in consequence, may be expected, in the second and third years' pasture, to give a more abundant yield under the greatest variety of circumstances than the other, even should the soil be favourable to its retention. On the farm of Charlton, near Montrose, where it was pretty extensively cultivated, it was remarkable for vigorous habit of growth, lateness of herbage, and permanency. Its price now is very little beyond that of the common red clover; but its persistent qualities, and strong succulent herbage, in the second and third years' pasture, would at once compensate for any extra original outlay. I conceive that it should invariably form part of a mixture of clovers and grasses for pastures of two and three years' duration, and therefore adopt and recommend its use.

Before proceeding to report particulars connected with the larger experiment already more than once alluded to, it may be proper here to consider the mode generally adopted throughout the country in laying down grass lands for two and three years' pasture. That it is open to serious objection, no one at all conversant with the method, and its frequently unsatisfactory results, will for a moment deny. There is something so peculiarly unscientific and unsound in invariably using the same mixture of clovers and grasses under all circumstances, without regard to variety of soil or diversity of situation, that one should think the merest reflection would suggest the adoption of a better practice. But such is not the fact; and the antipathy shown in numbers of instances to the adoption of tried and improved systems, because new, is sometimes greater than the tenacity with which old practices are cherished, although they had been long exploded, both by science and experience.

In districts where oats and barley are almost the only grain crops cultivated, it is usual to sow down grass seeds along with either of these cereals, upon ground which has previously borne a crop of turnips, or perhaps potatoes. It is customary in these cases to allow to the acre 2 bushels rye-grass seeds, if of home growth and middling quality; or 1½ bushel of Ayrshire, if tolerably heavy; or 1 bushel of Pacey's English variety, if it should appear clean, and exceed in weight 28 lb. per bushel. In addition to this, from 5 to 7 lb. of red and white clover are sown, (*Trifolium pratense* and *repens.*) In all ordinary cases, where such seeds in these proportions are used, an objection with very great propriety

might be raised as to the manner of covering them. This is done by the common harrow — an exceedingly useful implement, but which is made to overdo its usefulness when applied to covering in the smaller seeds, such as clover. I would recommend its discontinuance in covering in minute seeds, such as those of some of the indigenous grasses or clovers, and the substitution in all cases of the light grass-seed or bush harrow. If seeds are embedded in the soil beyond their vegetating depth, there is no circumstance so provoking or inconvenient to the farmer as the loss of good pasture.

The various mixtures of rye-grass and clover just alluded to, are adopted indiscriminately on all soils, in all situations, and under all circumstances. It matters not whether the soil be wet or dry, light or heavy, friable or tenacious; whether the situation be open and exposed, or low-lying and sheltered: the same invariable method in selecting and cultivating the seeds is adopted without consideration, and therefore without either skill or prudence. Those mixtures form, to the unalterable and undeviating upholder of old peculiar customs, what the main part of a piece of mechanism does towards its completeness; but although the main part of the machine, mathematically constructed, is perfect for its purpose, such stereotyped mixtures are not the best adapted to the varied circumstances in which they are employed.

Rye-grass on some soils is an exceedingly short-lived plant; indeed, it has been proved on peculiar conditions of soil and situation hardly to vegetate at all. On wet land, for instance, of inferior quality, or in indifferent condition, (of which there are yet extensive tracts, even with all the recent improvements,) the pasture generally will be found miserable. No doubt, primarily, in a case such as this, draining and fallowing and manuring are essential; but before good two or three years' pasture can be obtained, a reformation in the constitution of the mixture of pasture grasses must also be effected. But take the most favourable view we can of this method, and it is yet open to serious objection. Let the rye-grass and clover be sown on ground well suited for their growth and permanency—let the utmost care and skill be applied in cultivating the soil and depositing the seed—and we will yet find that their product in each consecutive season is not at all commensurate with the actual product which might be obtained by a different mixture. I practically arrived at this conclusion from an experiment made at Ellon Castle in 1847 and following seasons, on an extent of ground exceeding twenty acres. The field on which the experiment was made is in the vicinity of the castle, and about 200 feet above the level of the sea. The soil has a southerly exposure, and is composed partly of a dark silicious loam, and partly of a strong red clay, incumbent on a pebbly and clayey subsoil. It was in rather indifferent condition pre-

vious to the period alluded to, having been cropped irregularly and heavily; but as it was afterwards well drained and manured, it might be considered as of good or medium quality. The field was then ploughed, and the soil pulverised and reduced to a fine tilth. It was then divided equally, as regards extent of ground, and, with a view also to uniformity, of soil and situation.

On the 15th April 1847 the entire field was sown with oats, at the rate of 6 bushels per acre, and harrowed in the usual way; and on one division of 10 acres, the following grass and clover to the acre were afterwards sown:—

	s.	*d.*
2 bushels Ayrshire rye-grass,	11	0
4 lb. red clover,	2	4
3 lb. white ditto,	1	9
Total cost of seeds per acre,	15	1

On the other division of 10 acres, the following quantities of grass and clover to the acre were also sown:—

	Weight in lb.	Price per lb.	Cost. *s.*	*d.*
Pacey's English rye-grass,	10	3	2	6
Hard fescue grass,	1½	6	0	9
Meadow fescue grass,	1	0	0	6
Crested dog's-tail grass,	2	9	1	6
Italian rye-grass,	8	6	4	0
Cock'sfoot grass,	2	6	1	0
Common red clover,	2	7	1	2
Cow-grass,	3	8	2	0
White Dutch clover,	4	7	2	4
Total cost per acre,	33½		15	9

It will be observed that the cost of each of the above mixtures is very nearly similar.

The larger grass-seeds were sown by themselves first, and covered by means of the grass-seed or bush harrow; afterwards the clovers and smaller seeds of the indigenous grasses were sown, and rolled in by means of an ordinary-sized roller. The field, which carried a crop of oats averaging fully 7½ returns, was cut in the end of September. Considerable patches of the crop lodged in consequence of heavy rains during that season; and it is particularly to be observed, that as the lodgment occurred on both divisions, the permanency and luxuriance of the sward obtained from the mixture over that of the rye-grass and clover, was sufficiently perceptible on those spots. After the crop of oats had been removed from the ground, its surface was rolled; and this operation was again repeated in the spring of the following year. We may here incidentally remark, that it is important, at an early period of the year, before the plants have begun to exhibit much vivacity of growth, to have the surface of the ground rolled, as the alternate frosts and rains of winter and spring are

apt to loosen the hold that the plants have of the soil, and throw them out. The continued superiority of the pasture obtained from the new mixture was particularly noticeable towards the middle and latter end of April, from the greater richness and closeness of the herbage; and what realised the anticipations then entertained respecting it, and formed what may be termed the culminating result, was the comparatively superabundant weight of produce, when afterwards cut and ascertained, together with the more valuable and abundant pastures of the second and present year.

Towards the end of July, the produce of the field (which was originally intended for a hay crop) was cut, and two half-acres out of the respective divisions were marked off, in as nearly as possible corresponding degrees of quality of soil; and the produce of each half-acre weighed, respectively, of the mixed grasses division, 102 stones; and of the rye-grass division, 87 stones; which leaves 15 stones in favour of the former. The hay was of unexceptionable quality, and was eaten with equal, if not better, relish than the other. The after-math, which was very abundant, was depastured by a promiscuous herd of live-stock; and it was observable that the grass was uniformly relished.

2d Year.—The pasture of this year, obtained from the new mixture, was so superior to the other division of the field, that two well-known agriculturists early in spring spontaneously offered to give 10s. per acre more for the former than for the latter.

3d Year. — The general appearance of the pasture-grass for this year, obtained from the new mixture, was very much superior to the other in the early part of the season; and even at a late period, the verdure and comparative richness of this herbage on the pasture-land was so apparent, that one must refer it to the peculiar mixture of superior grasses and clovers, and not to any condition of soil, situation, or climate.

Tables of Grasses and Clovers suitable for various Soils.

I.—For Poor Silicious Sandy Soils.

	Weight in lb.	Price per lb.	Cost. s.	d.
Cynosurus cristatus,	2	9	1	6
Dactylis glomerata,	2	6	1	0
Festuca duriuscula,	2	6	1	0
Lolium Italicum,	8	6	4	0
Lolium perenne, Pacey's variety,	9	3	2	3
Trifolium pratense,	2	7	1	2
Trifolium pratense perenne,	2	8	1	4
Trifolium repens,	4	7	2	4
	31		14	7

II.—For Heavy Clay and Rich Alluvial Soils.

	Weight in lb.	Price per lb.	Cost. s.	d.
Cynosurus cristatus, . . .	1½	9	1	1½
Dactylis glomerata, . . .	2	6	1	0
Festuca pratense, . . .	3	6	1	6
Lolium Italicum, . . .	8	6	4	0
Lolium perenne, Pacey's variety, . .	10	3	2	6
Phleum pratense, . . .	2	6	1	0
Trifolium pratense, . . .	2	7	1	2
Trifolium pratense perenne, . .	3	8	2	0
Trifolium repens, . . .	4	7	2	4
	35½		16	7½

III.—For Soils of Medium Quality of the above.

	Weight in lb.	Price per lb.	Cost. s.	d.
Cynosurus cristatus, . . .	2	9	1	6
Dactylis glomerata, . . .	2	6	1	0
Festuca duriuscula, . . .	1½	6	0	9
Festuca pratense, . . .	1	6	0	6
Lolium Italicum, . . .	8	6	4	0
Lolium perenne, Pacey's variety, . .	10	3	2	6
Trifolium pratense, . . .	2	7	1	2
Trifolium pratense perenne, . .	3	8	2	0
Trifolium repens, . . .	4	7	2	4
	33½		15	9

Poa trivialis may be sown with advantage on either of the above soils, in low-lying or shaded situations.

Phleum pratense, in small proportion, might also be sown on medium soils approaching to a rich alluvial character.

In the event of seeds of *Lolium Italicum* not being had genuine or to be depended upon, it would be advisable to substitute, in each of the above cases, the same weight of Pacey's variety of *Lolium perenne.*

REPORT on the COMPARATIVE EARLINESS and PRODUCTIVENESS of EIGHT VARIETIES of OATS, WHEAT being a CROP in the ROTATION.

By George W. Hay, Esq. of Whiterigg, Melrose.

[Premium—The Medium Gold Medal.]

Two years ago I instituted experiments upon seven varieties of oats: viz., Potato, Sheriff, Berlie, Hopetoun, Blainslie, Sandy, and Barbachla. Having been dissatisfied with the kinds generally grown in this district, and feeling that the earlier varieties would be the best suited to the climate, provided there were bulk and quality united with earliness, I made use of those mentioned,

so as to test their respective values; and the result showed, in combining bulk and quality with earliness, that the Hopetoun stood first, Potato second, Sheriff third, Berlie fourth, Blainslie fifth, Barbachla sixth, and Sandy last.

The field on which these experiments were made having been in turnips in 1849, and ploughed up for a crop, I thought it a good opportunity, by repeating the experiment, to test the foregoing one; and having requested Messrs Lawson and Son to procure seed for me, of the best description, from rich light soil, the same portions of land were sown with the same varieties of oats, and the same man who before had sown the seed again sowed it in the succeeding year, 1850; so that the experiments may be considered as having been fairly conducted.

It may be premised that the field is of a stiff, cold, clay soil, with retentive subsoil, having been about ten years ago furrow-drained with stones 2½ feet deep and 24 feet apart; after which it was broken up from grass, a rotation taken, and again laid down in grass for three years, in each of which it was pastured with sheep and cattle. The lea was ploughed early in the autumn of 1847, and sown in the beginning of April 1848, which was the year of my first experiment. A Table of results of that year, in comparison with the experiment of this year, will be found farther on. After the oats were taken from the ground, the land was ploughed, and turnips sown the following spring, manured with a fair quantity of farm dung and 2 cwt. of guano per acre. The turnips were stripped, leading off four drills, and leaving two, which were eaten on with sheep; and the sheep having gone early over the field, it was ploughed in good time, and well mellowed with the frost.

In 1848 I could not procure seed of Early Angus oats in time; but having got seed in 1850, it was sown upon a portion of ground which last time was kept for it, immediately adjoining and lying between the Sandy and Barbachla; so that it does not in any way interfere with any of the varieties, but occupies the space which in the former experiment was kept for it.

It may be remarked that, in the former rotation, one-half of the field was in bare fallow wheat, and the other half in oats after turnips. The turnips were on that part where, in 1848 and 1850, the Potato, Sheriff, Berlie, and Hopetoun oats grew; and the wheat on that part occupied by the Blainslie, Sandy, Early Angus, and Barbachla.

The portion of ground which each variety occupied was found by measurement to be three quarters of an acre imperial; and as in the former experiment the seed was sown by the hand, the party sowing it was directed to take the same grasp of each kind, that it might be known how far the different kinds went.

The quantity of seed used upon each portion was thus:—

	Bush.	Tenths.	Weight per bushel.
Potato,	4	3½	44¼ lb.
Sheriff,	3	9½	42½
Berlie,	4	5¼	44
Hopetoun,	4	8¼	42½
Blainslie,	5	2	42
Sandy,	4	7¼	42
Early Angus,	4	2	43½
Barbachla,	5	8½	39

The first four kinds were sown upon the 26th, and the other four upon the 27th March, and all dry and well got in.

Upon the 20th April I found all the varieties brairded, the Sandy being farthest advanced.

On the 25th April I examined the brairds, and found the Sandy still ahead of the others, the Berlie next, and the Hopetoun the worst.

On the 6th May the brairds stood thus: The Sandy first, Berlie second, Blainslie third, Barbachla fourth, Early Angus fifth, Potato sixth, Sheriff seventh, and the Hopetoun worst; thus giving an entirely new feature to this experiment from the one conducted two years ago—the Sandy then being, with the Barbachla, the worst; whereas now the Sandy is first, and the Barbachla fourth.

On the 18th May, the weather having been cold and bleak ever since the last examination, the brairds were precisely the same as before, excepting that the Barbachla stands third, and the Blainslie fourth.

On the 5th July I went to test the degree of strength of each variety, as also to see how many of the kinds were in ear, and found the Early Angus in ear, also the Sandy, Sheriff, and Berlie, but not so far advanced; and the Potato, Barbachla, Blainslie, and Hopetoun, quite behind. Thus the relative position each occupied at that time was, as to earing—1st, Early Angus; 2d, Sandy; 3d, Sheriff; 4th, Berlie; 5th, Potato; 6th, Barbachla; 7th, Blainslie; 8th, Hopetoun. And as to strength, I found to appearance that the 1st was Berlie; 2d, Hopetoun; 3d, Potato; 4th, Sheriff; 5th, Blainslie; 6th, Early Angus; 7th, Sandy; 8th, Barbachla.

On the 20th August the Sandy and Berlie were reaped; on the 21st the Potato, Early Angus, and Barbachla; on the 23d the Sheriff and Hopetoun; and on the 26th the Blainslie. On the 2d September I counted the sheaves on the different portions of ground, and weighed a cart-load of each variety, consisting of 192 sheaves, taken from eight different parts along the ridges, so that a fair calculation might be made of the produce grown upon the whole portion, or per acre, and the results were:—

						Cwts.	St.
The Potato	yielded	644	sheaves,	192 sheaves	weighing	14	0
Sheriff	"	552		"	"	14	4
Berlie	"	604		"	"	13	2
Hopetoun	"	536		"	"	15	2
Blainslie	"	612		"	"	14	2
Sandy	"	508		"	"	13	6
Early Angus	"	498		"	"	13	2
Barbachla	"	565		"	"	12	4

The produce of the different kinds from the 192 sheaves, in good and light corn, was this:—

	Bush.	Tenths.	Weight per bushel.	Light Corn.
Potato,	13	9	43 lb.	27 lb.
Sheriff,	17	6	43	34
Berlie,	13	7	42	36½
Hopetoun,	15	6½	41	36
Blainslie,	12	7½	38	36
Sandy,	13	6½	41	35
Early Angus,	14	0½	40	33
Barbachla,	11	9	37	33

The produce, therefore, per acre of straw and corn, and of good and light corn, was this:—

	Tons.	Cwts.	St.	Lb.	Bush.	Tenths.
Potato,	3	2	4	12	69	0
Sheriff,	2	15	4	9	65	8
Berlie,	2	15	4	8	55	5
Hopetoun,	2	16	6	1	56	5
Blainslie,	3	0	4	6	52	2
Sandy,	2	8	4	0	47	0
Early Angus,	2	5	6	8	48	2
Barbachla,	2	9	0	4	45	1

The mealing quality of each kind was also tried, and found to be as follows:—

	St.	Lb.
Potato yielded, per 6 bushels,	11	1½
Sheriff, " "	9	9
Berlie, " "	10	6½
Hopetoun, " "	10	9
Blainslie, " "	8	13½
Sandy, " "	10	8
Early Angus, " "	9	7½
Barbachla, " "	9	9

The Table for 1850, which accompanies this, shows the results of all the eight varieties.

The *Hopetoun* gives more bulk of straw and corn from 192 sheaves than any of the others, but is deficient in the number of sheaves on the three-fourths of an acre to all, with the exception of the Sandy and Early Angus. It yields more corn per acre than the others, excepting the Potato and Sheriff; while it stands third in bulk of straw per acre, being next to the Potato and Sheriff; and it gives next to the Potato in regard to meal from the 6 bushels.

The *Sheriff* stands next to the Hopetoun in bulk of straw and corn from the 192 sheaves, giving considerably more corn from that number, and having more sheaves on the three-fourths of an acre; but while it is rather less in weight of straw per acre, it yields

about 10 bushels more corn. It is deficient in meal to all, with the exception of the Blainslie and Early Angus; but gives, with the Potato, the greatest weight per bushel.

The *Potato*, while it is deficient to the Hopetoun and Sheriff in bulk of straw and corn from the same number of sheaves, (192,) has by far the greatest number of sheaves on the three-fourths of an acre, giving the heaviest weight of straw, and the greatest number of bushels per acre, with the most meal from 6 bushels.

The *Blainslie* is next to the Hopetoun and Sheriff in bulk of straw and corn, but is deficient in gift of corn from the 192 sheaves to all the others, excepting the Barbachla; but there are more sheaves on the three-fourths of an acre than any, with the exception of the Potato, and it yields less meal from 6 bushels than any of the other varieties. It will be seen, however, that per acre, although it gives considerably less corn, it bulks well as to straw, being next to the Potato in that respect.

The *Berlie*, although it gives much less than most of the others in bulk of straw and corn, yields well in corn from 192 sheaves; and on account of the large number of sheaves on the three-fourths of an acre, it holds a good place among the others, both in weight of straw and quantity of corn per acre. It also meals well; and, with the Sandy, is the earliest variety.

The *Sandy*, *Early Angus*, and *Barbachla* are very much alike, and not at all to be compared with the others; being not only deficient in bulk of straw and corn from 192 sheaves, but also by the acre.

Thus, taking into account bulk of straw, gift of corn, and earliness, it will be seen that the varieties rank thus:—1st, Sheriff; 2d, Potato; 3d, Hopetoun; 4th, Berlie; 5th, Blainslie; 6th, Sandy; 7th, Early Angus; 8th, Barbachla.

The Table of results for 1848 and 1850 show that in bulk of straw and corn from 96 sheaves, (from which number the table of results in 1848 was made up,) every variety has increased in the latter year over that of 1848, with the exception of the Blainslie, which is one stone less, and of the Barbachla, which is precisely the same as it was before. In the case of the combined quantities of good and light corn from the same number of sheaves, the Potato, Blainslie, and Barbachla have fallen off; while with regard to weight per bushel, all have either remained the same or have increased, with the exception of the Barbachla, which is half a pound less.

The opinion I have formed from these experiments, as well as from previous observations, is, that upon stiff clay soil the early varieties which combine weight of straw and corn, and which the first four varieties do, are the best suited for this district, and ought to be more cultivated than they have hitherto been; and that the last four varieties, from their great deficiencies, in all respects, are less worthy of being retained.

TABLE OF RESULTS FROM AN EXPERIMENT ON THE EARLINESS AND PRODUCTIVENESS OF OATS IN 1850.

Names of the Varieties of Oats. — The portion of ground sown with each kind being, by measurement, ¼ of an acre.	Quantity of seed sown per imperial acre.		Weight per bushel.	When sown.	When brairded.	State of forwardness on 6th May.	State of forwardness on 5th July.	State as to strength on 5th July.	When reaped	Number of sheaves on ¼ of an acre.	Produce of straw and corn from 192 sheaves.		When led in and weighed.	When threshed and dressed.	Produce of good corn from 192 sheaves.		Produce of light corn from 192 sheaves.		Weight per bushel good corn.	Weight per bushel light corn.	Produce of meal from 6 bushels of each of the varieties.		Produce of straw and corn per imperial acre.				Produce of good corn per imperial acre.		Produce of light corn per imperial acre.		Total produce good and light corn per imperial acre.	
	Bush.	Tenths of bush.	lb	March	April	6th May	5th July	5th July	August	Sheaves	cwt	st	Sept.	Oct.	Bush.	Tenths of bush.	Bush.	Tenths of bush.	lb	lb	st	lb	tons	cwt	st	lb	Bush.	Tenths of bush	Bush.	Tenths of bush.	Bush.	Tenths of bush.
Potato, . .	6	0¼	44¼	26th	20th	6th	5th	3d	21st	644	14	0	2d	9th	12	9	1	0	43	27	11	1½	3	2	4	12	66	0	3	0	69	0
Sheriff, . .	5	2	42½	26th	20th	7th	3d	4th	23d	552	14	4	2d	9th	16	1	1	5	43	34	9	9	2	15	4	9	61	6	4	2	65	8
Berlie, . .	6	3¼	44	26th	20th	2d	4th	1st	20th	604	13	2	2d	9th	12	0	1	7	42	36½	10	6½	2	15	4	8	50	2	5	3	55	5
Hopetoun, .	6	7	42½	26th	20th	8th	8th	2d	23d	536	15	2	2d	9th	14	0	1	6½	41	36	10	9	2	16	6	1	52	0	4	5	56	5
Blainslie, .	6	9	42	27th	20th	4th	7th	5th	26th	612	14	2	3d	8th	11	1	1	6½	38	36	8	13½	3	0	4	6	47	0	5	2	52	2
Sandy, . .	6	2	42	27th	20th	1st	2d	7th	20th	508	13	6	3d	8th	12	1½	1	5	41	35	10	8	2	8	4	0	42	8	4	2	47	0
Early Angus,	5	6	43½	27th	20th	5th	1st	6th	21st	498	13	2	3d	8th	12	9	1	1½	40	33	9	7½	2	5	6	8	44	5	3	7	48	2
Barbachla, .	7	7	39	27th	20th	3d	6th	8th	21st	565	12	4	3d	8th	10	3	1	6	37	33	9	9	2	9	0	4	40	4	4	7	45	1

TABLE OF RESULTS FROM EXPERIMENTS ON THE EARLINESS AND PRODUCTIVENESS OF OATS IN 1848 AND 1850.

Names of the varieties of Oats, the portion of ground sown with each kind being by measurement ¼ of an acre.		Quantity sown per imperial acre.		Weight per bushel.	When sown.	When brairded.	When in ear—State of forwardness then.	State of varieties as to ripeness and strength.	When reaped.	Weight of straw and corn from 96 sheaves.		When threshed and dressed.	Produce of marketable grain from 96 sheaves.		Produce of light grain from 96 sheaves.		Weight per bushel of marketable grain.		Priority as to bulk of straw and grain.	Priority of quantity, good and light corn.	Priority as to weight of good corn.	Priority combining bulk with weight.	Priority as to earliness of ripening.	Priority combining bulk with weight and earliness.
		Bush.	Tenths of bush.	lb.			July.	Aug.		cwt.	st.		Bush.	Tenths of bush.	Bush.	Tenths of bush.	st	lb.						
Potato, . .	1848	6	6¼	44	April 4	May 3	3d	3d and 2d	Sept. 2	6	6	Sept. 28	6	5	0	5	3	0	3d	3d	1st	2d	2d	2d
.. . .	1850	6	0¼	44¼	March 26	April 20	5th	5th .. 3d	Aug. 21	7	0	Oct. 9	6	4½	0	5	3	1	4th	3d	1st	1st	2d	2d
Sheriff, . .	1848	6	9	40	April 4	May 3	2d	2d .. 4th	Sept. 1	6	0	Sept. 28	6	7½	0	5	2	13	5th	1st	2d	3d	2d	3d
.. . .	1850	5	2	42½	March 26	April 20	3d	3d .. 4th	Aug. 23	7	2	Oct. 9	8	0½	0	7½	3	1	2d	1st	1st	1st	3d	1st
Berlie, . .	1848	6	6¼	40	April 4	May 3	1st	1st .. 3d	Sept. 4	6	2	Sept. 28	5	5	0	5	3	0	4th	6th	1st	5th	1st	4th
.. . .	1850	6	3¼	44	March 26	April 20	4th	4th .. 1st	Aug. 20	6	5	Oct. 9	6	0	0	8½	3	0	6th	4th	2d	4th	1st	4th
Hopetoun, .	1848	6	6¼	42	April 4	May 3	4th	4th .. 1st	Sept. 2	7	0	Sept. 28	6	0	1	1	2	10½	2d	2d	3d	1st	3d	1st
.. .	1850	6	7	42½	March 26	April 20	8th	8th .. 2d	Aug. 23	7	5	Oct. 9	7	0	0	8¼	2	13	1st	2d	3d	3d	3d	3d
Blainslie, .	1848	7	3	40	April 5	May 3	7th	7th .. 5th	Sept. 15	7	2	Sept. 28	6	0	0	7½	2	9	1st	4th	5th	4th	5th	5th
.. .	1850	6	9	42	March 27	April 20	7th	7th .. 5th	Aug. 26	7	1	Oct.	5	3	0	8¼	2	10	3d	5th	5th	5th	4th	5th
Sandy, . .	1848	7	3	—	April 5	May 3	5th	5th .. 7th	Sept. 15	4	3	Sept. 28	4	5	0	5	2	13	6th	7th	2d	7th	4th	7th
.. . .	1850	6	2	42	March 27	April 20	2d	2d .. 7th	Aug. 20	6	7	Oct. 8	6	0¾	0	7½	2	13	5th	7th	3d	6th	1st	5th
Early Angus,	1848	—	—	—	—	—	—	..	—	—	—	—	—	—	—	—	—		—	—	—	—	—	—
..	1850	5	6	43½	March 27	April 20	1st	1st .. 6th	Aug. 21	6	5	Oct. 8	6	4½	0	6¾	2	12	7th	6th	4th	7th	2d	6th
Barbachla,	1848	6	9	—	April 5	May 3	6th	6th .. 6th	Sept. 7	6	2	Sept. 28	6	0	0	5	2	9½	4th	5th	4th	6th	5th	6th
..	1850	7	7	39	March 27	April 20	6th	6th .. 8th	Aug. 21	6	2	Oct. 8	5	1½	0	8	2	9	8th	8th	6th	8th	2d	7th

REPORT OF EXPERIMENTS ON THE COMPARATIVE EARLINESS AND PRODUCTIVENESS OF DIFFERENT VARIETIES OF BARLEY.

By Mr John Mitchell, Wester Alves, Elgin.

[Premium—Five Sovereigns.]

Each district of a country, and every variety of soil in that district, has perhaps some particular variety of grain more congenial to its peculiar circumstances than any other kind that might be cultivated upon it; and it is matter of common observation that there are some varieties of particular grain which establish themselves in a district and exclude the cultivation of all others. In Morayshire, where the experiments now to be reported on were made, barley is extensively and successfully grown—the varieties most commonly cultivated being the Common and Chevalier. Chevalier is thought more suited to a heavy description of soil, and should be early sown. The Common is considered best adapted for light soil, and, being early of ripening, may be sown later than the Chevalier.

In order to put these popular notions to the test in regard to those two varieties of barley, the two first experiments were instituted.

The soil upon which experiment No. 1 was made, forms the bed of an old loch. The loch was drained about twenty-five years ago, but the land was not dried, and was very unproductive until furrow-drained by me in 1840. This soil is of a light sandy description, on a subsoil of sandy clay, so that, until furrow-drained, the surface was easily made wet by rain, and remained long in that state, making the land very unproductive. Since it has been drained, it produces fair crops of every description, and is yearly improving. In 1848, the part of the field experimented on with barley was under a crop of potatoes. In the following year, the barley having been sown as early as the 10th of April, and the Chevalier variety being expected to give the best crop, the whole field, with the exception of a quarter acre, was accordingly sown with that variety—the quarter acre being sown with Common barley; but it will be seen from the Table that, over a field of 20 acres, there would have been a considerable gain in the produce of grain had it been all sown with Common barley instead of Chevalier, although the straw of the Chevalier gave the greater return.

Experiment No. 2 was made upon a different part of the farm, about a mile distant from Experiment No. 1, the soil being a poor gravelly loam, with a hard gravelly bottom. The field grew a crop of turnips in 1848, which was half eaten off with sheep, and half carted off to cattle. The four lots were upon four adjacent

ridges, each 10 yards wide and 121 yards long, making a quarter of an acre to each lot. Here again the Common and Chevalier varieties were put in competition, and tested together at two different periods of sowing. The Table gives the results, and, like the former experiment, the early Common has the advantage in grain, but not in straw, while the late-sown Chevalier has the advantage over the late-sown Common in both grain and straw. This is again contrary to the popular idea in such cases, and shows the advantage of precise experiments.

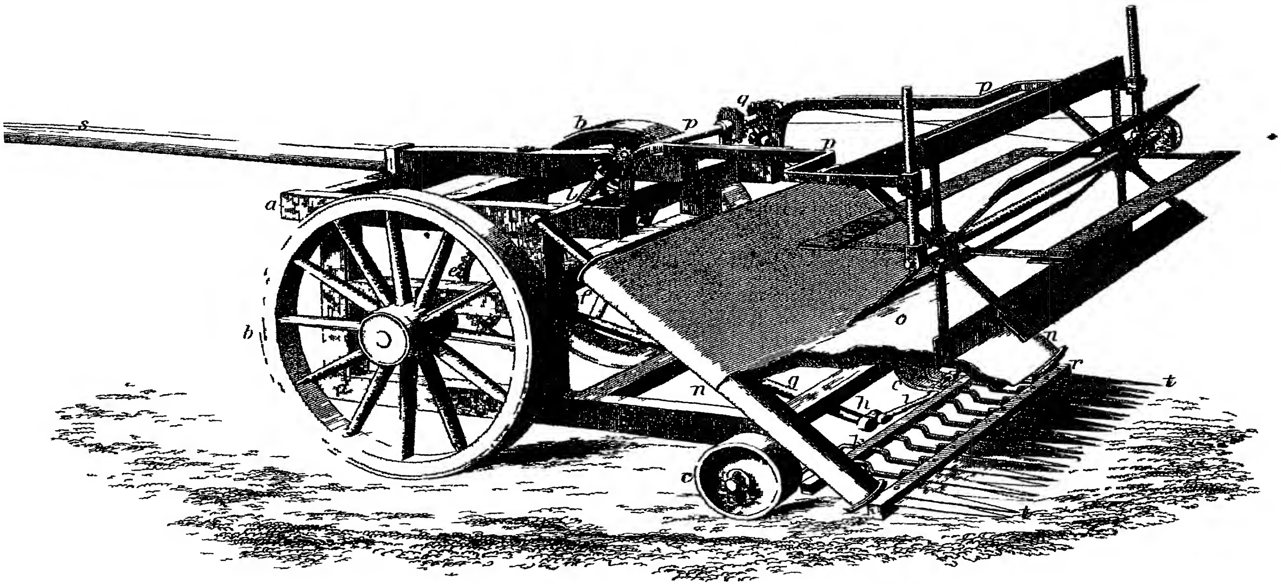
Experiment No. 3 was made on the same farm, but on a different soil from either of the foregoing—being a clay loam of good quality, on a partially porous clay subsoil. The field was furrow-drained in 1839, and afterwards subsoil ploughed. It carried a crop of Swedes in 1848, after wheat. The ground for the Swedes was prepared in the usual way, and manured with 30 loads of farm manure in the drill, with $3\frac{1}{2}$ cwt. guano and 5 bushels of bone-dust per acre, mixed together, and sown over the dung. The crop of Swedes was about 30 tons of bulbs per acre. In order that as little difference as possible might exist in the nature and quality of the lots on which the different varieties of the barley were to be sown, one ridge, of 10 yards wide and 121 yards long for each, was chosen at one end of the field, where the soil was very equal and similar in all respects, and the lots lying contiguous. Each lot contained one quarter of an imperial acre, and was sown with 1 bushel of grain, with the exception of lot 10, containing the Chili barley, of which there was only sown one-fourth of a bushel on one-sixteenth of an acre. The Black barley seed was the produce of a very small parcel which was sent by post to me from England in 1847, which I dibbled; and in the following year, when the produce reached about 1 bushel, I took the bushel for the seed of the experiment. The seed of the Six-rowed barley, Victoria bere, Italian, Annat, and Chevalier (No. 2) barley, were grown on a clay soil in Mid-Lothian. The Common and Chevalier (No. 1) were grown for two or three years on the farm without change. The Old English was from the county of Stirling, grown on a late clay soil, and was the stock of the sample which carried the first prize at the Stirling competition for seed grain in the spring of 1849. The Chili was a small parcel direct from that country in 1848, and grown on the farm that year, thinly dibbled,—the produce being the seed for experiment. The Table gives the results of this experiment. It will be seen that, with the exception of the Black and Chili varieties, the difference among all the kinds as to the quantity of grain is very trifling, and might have arisen had the whole field been sown with the same variety. It must be remarked that the field was in the highest state of cultivation; and, as the season was particularly fine, it is possible that

3 bushels of seed would have given a larger acreable produce, and fully as fine a quality, of grain. The whole was sown in one day; but there are considerable differences in the earliness of ripening—the Old English, from a late soil and climate, being the first, with the exception of the Chili; the Common being only two days later, and the Chevalier nine days. The Old English has also the finest grain, having least light grain, and the heaviest sample by 1¼ lb. It is, however, deficient in bulk of straw; but this is no great drawback in the circumstances, the whole of the varieties being heavy of straw, and much lodged. Black and Chili barley seem quite unsuited for this soil and climate. Every year the Black barley was sown, the produce was inferior to the seed; and the quality of crop 1849 was very coarse, light, and inferior, and the produce also less than any of the others. The colour was yearly becoming fairer; and it is believed that, had its cultivation been continued, the peculiarity in the colour would have disappeared. The Chili barley also became coarser. Of the produce in the experiment, the grains were very large and rough, and the weight per bushel little more than good rye-grass seed. The straw was short; and the only advantage it had over the other was its being first ripe—no great benefit, considering its deficiencies in all other respects. From the whole of the experiment, it will be seen that the Common and Chevalier varieties are the most suited for the particular soil, climate, and season of any of the varieties experimented on—the Old English being merely a change of seed of the Common variety; the change of seed of the Chevalier also having the advantage of the seed of the same variety grown for some years on the farm. All the other varieties were inferior to these two in every respect; the experiment, which was conducted with much precision, showing that they could not be cultivated with profit in the same circumstances.

TABLE

TABLE OF COMPARATIVE RESULTS FROM VARIETIES OF BARLEY OF CROP 1849.

	Names of varieties sown.	Quantity sown per imperial acre.	Weight per bushel when sown.	When sown.	When brairded.	When in ear.	When ripe, or fit for reaping.	When reaped.	When threshed.	Produce of marketable grain per imp. acre.	Produce of light grain per imperial acre.	Weight per bushel of marketable grain.	Weight per bushel of light grain.	Weight of straw per imperial acre.
		bu. pks.	lb.							qrs. bu. pks. lip.	qrs. bu. pks. lip.	lb.	lb.	Imp. stones, lb.
In Experiment No. 1	Common barley, . .	4 0 1/7	56	April 10	April 30	July 5-12	Aug. 29	Aug. 29	Sept. 28	4 1 2 2	0 4 1 2	53	48	188 7
	Chevalier do., . . .	4 0 1/7	58	,, 10	,, 30	,, 14-18	Sept. 7	Sept 7	Dec. 14	4 0 1 2	0 2 2 1	55	49	196 0
Experiment No. 2	Common barley, early,	4 2	55	April 28	May 14-18	July 12 to 16	Sept. 10	Sept. 21	Dec. 10	5 1 0 1	0 3 1 2	52½	48	212 7
	Chevalier do., . . .	4 2	58	,, 28	,, 14-18	,, 16 to 20	,, 21	,, 21	,, 10	4 7 0 1	0 5 1 1	53½	49	223 0
	Common do., late, . .	4 2	55	May 5	,, 21-24	,, 16 to 21	,, 21	,, 21	,, 12	4 0 3 1	0 3 2 3	52½	48	241 0
	Chevalier do., . . .	4 2	58	,, 5	,, 21-24	,, 20 to 26	,, 21	,, 21	,, 12	4 6 2 0	0 3 1 2*	53½	49	292 5
Experiment No. 3	Black barley, . . .	4 0	48	April 25	May 10	July 21 to 26	Sept. 20	Sept. 20	1850. Jan. 24	4 7 0 0	1 0 1 0	44	34	357 10
	Six-rowed do., . . .	4 0	49	,, ,,	,, 6	,, 9 to 14	,, 10	,, 13	,, 25	6 6 3 0	1 0 0 0	46½	35	336 2
	Victoria bere, . . .	4 0	50	,, ,,	,, 5	,, 2 to 9	,, 8	,, 13	,, 25	6 5 1 0	0 4 1 0	50	38½	223 9
	Italian barley, . . .	4 0	53	,, ,,	,, 1	,, 14 to 20	,, 12	,, 13	,, 25	6 4 1 0	0 5 0 0	51	39	303 2
	Annat do., ...	4 0	54	,, ,,	,, 3	,, 16 to 20	,, 12	,, 13	,, 26	6 7 2 0	0 3 0 0	53	40	345 5
	Common do., . . .	4 0	55	,, ,,	,, 4	,, 9 to 14	,, 8	,, 13	,, 26	6 6 2 0	0 6 2 0	52	44	341 2
	Chevalier do., seed of farm, ...	4 0	58	,, ,,	,, 9	,, 16 to 21	,, 15	18	,, 24	6 5 2 0	0 4 2 0	53½	45	353 10
	Chevalier do, seed from Mid-Lothian, . .	4 0	58	,, ,,	,, 8	,, 16 to 21	,, 15	,, 18	,, 24	6 7 0 0	0 4 2 0	54	47	305 4
	Old English barley, .	4 0	58	,, ,,	,, 2	,, 5 to 10	,, 6	,, 13	,, 3	7 0 0 0	0 1 1 0	55½	43	241 10
	Chili barley, ...	4 0	48	,, ,,	,, 7	,, 2 to 9	,, 3	,, 3	,, 3	5 2 0 0	0 5 0 0	35	20	253 8



REAPING MACHINE
INVENTED IN 1828
by
The Rev^d Patrick Bell Minister of Carmylie

W. A. F. Johnston, Edin^r

REPORT ON REAPING-MACHINES.

By Mr James Slight, Curator of the Society's Models.

The process of reaping the crop in the season of harvest is the most engrossing event of the agricultural year, and that in which all the other operations of the farm may be said to centre. It is not surprising, therefore, that, from the earliest periods in the history of agriculture, there have been, from time to time, attempts made to facilitate the operation of harvest by the aid of machinery, more or less complex, for cutting down the cereal and leguminous crops. But it is a fact, not less curious than unaccountable, that this operation of reaping, simple though it may appear, continues to be almost entirely performed by the sickle and the scythe. There have certainly been examples, both in Britain and the Continent of Europe, and more recently to a considerable extent in America, of the application of mechanical means to this important purpose, but the attainment of a completely effective reaping-machine is an object yet to be sought for. In the present year an unusual degree of interest has been produced by two American reaping-machines which appeared in the great Exhibition, and which, under the general excitement of the period, as well as by being studiously brought into view, have had the effect of attracting a large share of public attention. From the great importance of the subject, and the wide distribution of advantages likely to arise from a really successful solution of a problem so long sought for, the present seems an appropriate time to take a retrospect of the progress of the reaping-machine during the past half-century, and, by so doing, endeavour to arrive at something like the due degree of merit appertaining to the different inventors and operators, as well as to establish for Scotland the claim of having produced, and for the Highland and Agricultural Society of having encouraged, the original of the machines now introduced from America.

Previous to the commencement of the present century, there had, even from the period of the Roman greatness, been occasional attempts at the accomplishment of a process by which the grain crops might be more expeditiously cut down than by the sickle; but none, it would appear, had ever assumed such a satisfactory form as to induce agriculturists to adopt them. Of the structure of such abortive attempts at a reaping-machine, little information has come down to us, and that little is vague and unsatisfactory. Nor is it of much importance that we are not in possession of direct information respecting them, seeing that nothing effective had ever arisen out of these attempts.

Soon after the cemmencement of the present century, when agricultural improvements were making progress in every direc-

tion, by the extension of the use of improved machinery to the various branches of the art, the important department of the harvest operation naturally occupied a share of the inquiries then going on. Agricultural societies, too, by the offer of premiums, called forth the energies of inventors, both amateur and practical, in this particular line. Very early in the century we learn of Boyce's reaping-machine, for which he secured a patent. This was based on the revolving-cutter principle; but the revolver was armed with a series of short scythes, which cut the corn as the machine moved along. It was destitute, however, of a proper apparatus for gathering and depositing the corn after being cut, and hence it never reached any degree of success.

About the same period, one Plunket, a London implement-maker, made a similar attempt, also on the revolving principle; but in place of the scythe of Boyce, he adopted a circular cutter, toothed like a fine saw or sickle. Being destitute, also, of a proper gathering apparatus, this machine acquired no reputation, and speedily was laid aside.

Nearly about the same time, 1806, Gladstone, a millwright, of Castle Douglas, Kirkcudbrightshire, brought out a reaping-machine that excited much interest, and possessed considerable promise. Its principle was the revolving circular smooth-edged cutter, supported in a carriage-frame, with two main-wheels only. A pair of long horse-shafts projected forward at one side, so that the horse walked alongside the standing corn—thus *drawing* the machine. The circular-cutter was ingeniously overlapped by a sort of shield, armed with pointed prongs, projecting in front of the cutter, which served to collect and to hold the straw until the cutter had done its work. A complicated and peculiar apparatus was applied as a gatherer, to collect and deliver the cut corn in small parcels like handfuls. This machine, as given in the *Farmer's Magazine*, vol. vii., appears to have possessed great ingenuity of contrivance as a whole. Its cutter also appears to have been formed on a sound principle; and it was, besides, provided with an apparatus, by which the cutting edge could be whetted as often as necessary without stopping the action of the machine. Its gathering apparatus, however, carries too conclusive evidence that upon that member of the construction the whole design had failed, and the machine sank into oblivion like its predecessors.

At a still later period Mr Salmon of Woburn brought out a reaping-machine, under promising circumstances. In this there appears the first indications of a cutter on the clipping principle, combined with an apparatus for collecting and delivering, that promised to lay the cut corn in parcels like sheaves ready for binding. Although this invention seems to have been brought out under the most flattering hopes of success, it does not appear to have ever obtained the approbation of the class for

whose use it was intended, and has been, like its precursors, almost forgotten.

We may advert to one or two others in their proper order of date; of these the first is that of Mr Scott of Ormiston, factor to the Earl of Hopetoun, an amateur mechanician of no small merit. During the war, in the early part of the century, he had directed his mechanical views to the construction of self-acting floating-machines or vessels for the purpose of disabling or destroying the fleets or ships of the enemy by stratagem. With the peace of 1815 he found that "occupation gone," and very adroitly turned his talent towards more peaceful objects. Amongst these came his reaping-machine, which, like most others, as the writer well remembers, was an object of considerable interest for a time, although it ended in a failure, like those that had gone before. Mr Scott's machine had a cutter acting on the revolving principle, though not a circular cutter, but a wheel carrying sixteen small-toothed sickles, and had projecting prongs in front of them, like Gladstone's. He had copied Mr Smith's imperfect gatherer, (an inverted conical drum,) but added to it twenty-four jointed prongs or fingers, acting in the form of collectors or rakes, which were expected to convey the cut corn from the cutter to the ground. This machine was supplied with other contrivances, such as a brush to keep the cutters free of stubble or weeds, which might otherwise have stopped their proper action; but with all these precautions and auxiliary appendages, it is known that the machine never performed beyond a mere trial.

About 1822, Mr Ogle, at Renington near Alnwick, invented a machine, by which he and a Mr Brown of Alnwick engaged to combine every act of reaping, except binding and placing the sheaves in stook. This machine is reported to have performed very satisfactorily in the field upon wheat and upon barley; but in consequence of no encouragement being given to the makers, the manufacture of the machine was dropt after the first complete specimen was made. The inventor in 1826 published a drawing and description of the machine in the *Mechanics' Magazine*, vol. v., from which the following abstract is taken. The framework or body of the machine closely resembled a skeleton of a common cart, with its wheels and shafts, to the latter of which the horses were yoked to *draw* the machine, walking by the side of the standing corn. To the right of the carriage was projected the cutting apparatus—a light frame, whose front bar was of iron, and armed with a row of teeth three inches long, projecting forward; immediately upon these teeth lay the cutter, a straight-edged steel knife, equal in length to, and a little more than the breadth of the corn to be cut at one passage. By a motion from the carriage wheels, this knife was made to vibrate rapidly from right and left,

as the machine travelled. Above, and a little before the cutter, a fan or vane was, from the same source, made to revolve, which thus collected and held the corn to be cut by the knife; and, on being cut, was by the vane carried backward, and laid upon a deal platform immediately behind the cutter: here, by the assistance of a man with a rake, it was collected to the extent of a sheaf, and then discharged.

There is here observable a very curious coincidence in the almost perfect sameness, in every point, between Ogle's machine and one of the American reapers, Mr M'Cormack's, to be afterwards noticed; the similarity is so perfect that the description of either would suit equally well for the other. But the curiosity of it is lessened from the consideration that similar coincidences are not uncommon amongst mechanists.

A case of this kind actually occurred at the period of Mr Smith's invention of his reaping-machine, in Mr A. Kerr of Edinburgh having produced a small model proposed as a reaper, in which the *cutter* and *gatherer* were exactly on the same principle as those of Mr Smith, and were admitted to be so by that gentleman. Kerr's model, still in the Museum of the Highland and Agricultural Society, exhibits these two members precisely as admitted; and placed within them is a pair of small wheels, which are all that appears for a first mover. That such wheels could ever have served the purpose of impelling the action of a reaping-machine seems altogether improbable, though very applicable as an auxiliary to support the cutter at a proper height. To this defect it is easy to ascribe the failure of Kerr's machine, when extended to a working size.

It were easy to extend the number of competitors in this field of invention. At the period here spoken of they were numerous, besides occasional aspirants since; but, with the exception of the three principal, yet to be noticed, none seem to have proceeded beyond the formation of an imperfect model.

Mr Smith of Deanston, afterwards so well known as an agriculturist, came on the field with his reaping-machine in the year 1812, with very considerable promise of success. Mr Smith, having been well trained as a mechanician, and being conversant in all the mechanical inventions and applications of machinery of the period to various manufacturing purposes, and having, of course, observed the numerous and successful applications of rotatory motion in preference to any kind of reciprocating action, wherever the former could be applied, was very naturally led to the adoption of the continuous rotatory action in the construction of a reaping-machine. This principle he accordingly did adopt, and, although his first trials were not altogether successful, they were such as led to a series of improvements that brought the

machine, as we shall see, to a degree of efficiency which promised ultimate success. The Dalkeith Farming Society had previously offered a handsome premium for the invention of an effective reaping-machine, and Mr Smith became the only competitor in 1812. In the following year the machine, in its improved state, was again exhibited in operation before a committee of the Dalkeith Club, when they, although not considering it entitled to the full premium, voted to Mr Smith a piece of plate, value fifty guineas; and shortly after, the Highland and Agricultural Society having appointed a committee to examine and report on its efficiency, found that report so satisfactory that a piece of plate of fifty guineas' value was in like manner voted to the inventor, and at the same time a complete model of the machine was lodged by Mr Smith in the Society's Museum.

In its original form, this machine consisted of a horizontal wooden frame of about 7½ feet long and 3 feet wide. Beneath this was attached the main axle and pair of broad wheels, of about 5 feet high, the axle turning with the wheels by means of spring and ratchet, and carrying a spur-wheel, which geared into another fixed upon a shaft placed above the wooden frame, and parallel to the main axle, and thus gave motion to the succeeding movements of the machine. This last shaft carried a pair of reversed bevel-wheels, loose on their shaft, while they continued both in contact with a third wheel fixed on a shaft, placed horizontally above the frame; a sliding clutch on the former shaft brought either of the two bevel-wheels, at the pleasure of the conductor, into action with that upon the horizontal shaft, by which arrangement that shaft was turned to the right or to the left, or by placing the clutch so that neither was in contact with it—the third wheel, and its shaft remaining stationary. On the forward end of the horizontal shaft was placed another bevel-wheel acting upon the pinion of an upright spindle; and this spindle, supported on the forward extremity of the horizontal frame, assisted by a three-ribbed iron arch raised above the frame, was, by means of the two bearings, kept sufficiently steady for its duty of carrying the circular cutter at its lower extremity. Here, however, the spindle had a further support from a pair of small wheels and frame, placed under the foot of the spindle, and by a stay of iron proceeding from the hinder part of the frame. The cutter, 5½ feet in diameter, was composed of thin steel segments bolted upon an iron ring, and this last was surmounted by an inverted frustum of a cone, formed of sheet-iron, whose lower diameter was 10 inches less than the cutter, or 4 feet 8 inches, while its diameter at top was 5 feet 4 inches. The front wheels under the cutter were only 14 inches diameter, and about as much apart; their duty was to keep the cutter at the regular distance from the ground to which it might be set for the time being. The gearing above described was so arranged

as to bring out a velocity in the edge of the cutter, such that, for every inch of progressive motion of the whole machine, any point in the edge of the cutter passed through a space of 9 inches in its motion of revolution. The machine was moved by two horses yoked to a pole fixed to the wooden frame, and projecting from behind, so that the horses pushed the machine before them by drawing with trace-chains from a yoke-bar attached to the end of the pole behind them. By means of the clutch and bevel-wheels, the cutter could be made to revolve to right or left, and the cut corn laid down right or left accordingly; convenient means were also provided for placing the cutter higher or lower at pleasure, by means of a lever that lifted or lowered the cutter and conical drum, acted upon by a chain and screw, the latter brought to a convenient point at the end of the pole. In working, the grain was cut regularly and well. The drum revolving with the cutter carried the cut corn round until it fell off at the side of the machine in a pretty regular continuous swathe.

The description here given applies to Smith's machine, after it had undergone some improvements up to 1814; from that period, at occasional intervals, it was brought out with renewed hopes of success, until, in 1835, at the Highland and Agricultural Society's Show at Ayr, it was exhibited in operation with remarkable eclat. Mr Smith had now engrafted upon it an important addition, borrowed from a machine, which has yet to be described, invented by Mr Mann of Raby, Cumberland. This was the attachment of a series of rakes placed vertically upon the periphery of the original drum, the teeth of the rakes being about 6 inches long. This served the purpose of a more certain conveyance of the cut corn to the place of delivery at either side of the machine. Although the application of the rakes was less efficiently done than in the machine from which the idea was taken, their velocity being here the same as that of the cutter, they nevertheless seemed to facilitate the process of gathering, which hitherto had been imperfect. The experiment was made on a field of wheat in a fair condition for being cut by a machine. The operation began, not at an outside, as was usual, but right in the middle of the field, the spectators being placed around the point of commencement; and amongst these the writer had the fortune to be placed. The passage of the machine through the field left behind it an open lane, where nothing was at first observable but a bare stubble, the cut corn being all laid down at one side against the standing. Never, perhaps, did an experiment come off with better effect, or greater success; the general impression was that the problem had at last been solved — that Smith's machine was complete. Not so was it, however, in fact; for, notwithstanding the striking effects produced by that day's trial,

the machine remained, and to this day remains, without making further progress.

It is more than probable that the failure of this machine rested mainly on the following defective points—1st, From its great length and weight, it was unwieldy in all its movements; 2d, From its great length also, and from the mode of attachment of the horses, together with the want of a swivel-carriage either before or behind, it was defective in turning at a landing; and, 3d, From the small diameter of the bearing front wheels, and especially from these being placed nearly direct under the centre of the revolving cutter. This last and important member, when these wheels fell into a furrow, ran right into the brow of the adjacent ridge, and thus destroyed for the time the whole edge of the cutter, its projection before the wheels being nearly 2½ feet. And 4th, It may be stated as an objection—namely the price, which probably could not have been much under £50.

The next important step in this direction was taken by Mr Joseph Mann of Raby, Cumberland, who brought out a reaping-machine in 1820, in the state of a working model, before the Abbey Holme Agricultural Society, who expressed their approbation of the design, and advised a horse-power machine to be constructed with some proposed alterations, one of which was that the horses should *push* instead of *draw* the machine, the model having been upon the latter principle. These alterations seem to have turned out rather unsuccessful, for in 1822 a full-size machine was exhibited to the same society; but the mechanist having endeavoured to satisfy too many opinions, his machine became so complicated that its success was doubtful, and it fell aside till 1826, when Mr Mann returned to his favourite method of *drawing* instead of pushing; and from this period to 1830 he was, from time to time, engaged in completing his improved design, which, from his own statement, at last possessed the four principal points of a good reaping-machine. 1st, It preserved the parallelism of the line of draught, though that draught was applied to one of its angles in front; 2d, A polygonal cutter; 3d, The gathering process from the cutter, performed by a revolving series of rakes; and, 4th, The process of stripping the rakes in such manner as to lay down the cut corn in a regular swathe by the side of the machine as it progressed.

Mr Mann's machine, possessing the above described points, was exhibited at the Highland and Agricultural Society's Show, held at Kelso in 1832. On this occasion the writer had ample opportunity of studying its construction, and also witnessed its trial on a small portion of a field of oats, performed under very unfavourable circumstances. The portion of the field acted upon had been later than the other parts, hence it was left uncut, and was still unripened, and withal thought so worthless that cattle had been allowed to

traverse it. But notwithstanding all this, the machine performed the operation of cutting much better than could have been expected under the circumstances, while the laying of the cut corn in the swathe was performed very regularly. In working up-hill, and especially in crossing the ridges, its operation was less satisfactory; and on the whole, although the trial called forth much approbation, the judges could not take upon them to recommend a premium. Nevertheless it must be admitted that, making allowance for Mr Mann being only an amateur mechanic, and having constructed the machine almost entirely by his own hands, it could not be expected to be other than a rude specimen of mechanism, and, therefore, not capable of doing all that the principles involved ought to have brought out: it deserves, however, to be looked upon as possessing the germs, at least, of the *four points* which its author held to be the ultimatum sought for in a reaping-machine. It is the opinion of the writer also, in looking back, that the principles of that machine, in the hands of an able mechanician possessed of capital, (for of that commodity, like many others of his kind, the inventor was deficient,) might have placed it foremost in the competition for the solution of the problem.

As it may be interesting to those who may yet turn their attention to the construction of the reaping-machine, the following description is given from the writer's original paper, published with drawings in the Journal of Agriculture, which for more minute details may be consulted by the machinist.* In Mann's machine, the cutting process is performed on the revolving principle; but instead of a circular cutter like Smith's, one of a polygonal form had been preferred, having twelve equal sides. By this form of cutter the action upon the standing corn is somewhat different from that of the perfectly circular cutter: with the latter the cutting edge is constantly and equally acting upon the standing corn, but with the polygonal the effect is a rapid succession of strokes, arising from the inclination of the cutting edges in the sides of the polygon to each other; for, as will readily be understood, from the angles of the polygon being farther from the centre of revolution than any point in the straight side thereof, any opposing body, as a stalk of corn, will be forcibly acted upon when the angle is passing the stalk; and, if passing without completing the separation, the progressive motion of the whole machine will not only keep the edge in contact through the first half of the passing side of the polygonal edge, but as the next angle approaches the stalk, it will receive the more impressive stroke from the remaining half side to complete the severance—and so of all the rest.

The cutter is formed in twelve separate segments of thin steel

* *Journal of Agriculture,* vol. i. p. 250.

plate, fixed upon the extremities of a corresponding number of horizontal arms attached to a vertical revolving shaft. The joinings are formed by the ends of the segments lapping over each other, and situate posteriorly to the angles of the polygon in relation to its motion of revolution. The segments of the cutter were attached to the revolving arms by means of a slender slide-bar of iron, riveted on to each end of the segment; and these sliders, two together, being those of the contiguous ends of two segments, were passed through a clasp in the ends of the arms, and there secured by a pinching screw. This mode of attaching the cutter rendered the removal for sharpening extremely convenient, as a whole spare set of the segments could be carried with the machine, the change of the one set for the other being capable of accomplishment in a few minutes. The cutter, when completed with all its segments, was 4½ feet diameter; and taking the rate of progressive motion at 2½ miles per hour, the cutters made 175 revolutions per minute, which corresponds very nearly with the rate in Mr Smith's machine.

The framework of Mann's reaper was of rather irregular construction: in plan its form was that of a trapezium, the sides parallel, the back at right angles to them, and the front side had the acute angle at the left or nigh side, and to that the draught was applied by means of a pair of horse-shafts. This framework was supported on three principal wheels: of these, two had a diameter of 3 feet, one being on each side towards the rear, but that on the off-side about a foot in advance of the other, and from the axle of it alone the movements of the working parts was derived. The third wheel had a diameter of 2 feet, and was attached to an upright or rather a sloping swivel shaft, placed in connection with the acute angle of the framework, and to which the horse-shafts were firmly attached—making thus to the machine a swivel or fore-carriage, by which it could be directed or turned round in a small space. A fourth and much smaller wheel or roller worked in the fore-end of the perch that extended from the lower part of the framework, and on which rested the foot of the cutter-shaft directly over this fourth wheel; but of its utility there are doubts.

One of the peculiarities of this reaper was the application of the revolving rakes to gather the corn as it fell from the cutter. This was accomplished by the construction of a skeleton cylinder, placed over and revolving concentrically with the cutter upon the upright shaft of the latter, but independently of it, and with a different velocity. The cylinder was mounted with 25 rakes attached to it in a vertical position, each rake having 10 teeth of about 6 inches long. The revolutions of the rake-cylinder were made in the same direction as the cutter, but at a rate only as one to seven of the latter—namely, about 28 per minute. To com-

plete the gathering part of the process, a second and fixed rake or comb was attached in a vertical position to the near side of the framework. The wooden teeth or prongs of this comb were of considerable length, and were projected horizontally between the lines of teeth in the revolving rakes. In the latter also a ring of light wire was carried round each row of the teeth horizontally, having an attachment to every tooth about 2 inches from its root; and as the point of the prongs of the comb lay within or nearer to the centre of revolution than those rings of wire, not a single straw could escape the comb, but were all regularly stript from off the rakes as they came round. The cut and gathered corn was thus regularly laid down in a continuous swathe, the stalks of grain lying parallel to each other, and nearly at right angles to the line of progress of the machine.

The gearing of this machine was extremely simple. On the axle of the off-side carriage-wheel, already alluded to, was fixed a bevel-wheel of 56 teeth, which acted on a horizontal wheel of 28 teeth; and upon the vertical shaft of this last were mounted two pitch or chain wheels, the one of 8 teeth, the other 28; these, by means of two pitch chains, acted upon two other wheels of 21 and 9 teeth respectively, placed upon the rake-cylinder and upon the cutter-shaft, bringing out the velocities before named for the two members. Besides these active motions, there was provision by means of levers, by which the height of the stubble could be regulated almost instantaneously, and the revolving parts thrown out of gear, and also for raising or depressing either side of the machine, to suit the rounding of ridges and deep furrows. The power required to draw this reaper was one horse, and with this it cut down a breadth of 3 feet; so, taking its rate of travel at 2½ miles per hour, its performance, by calculation, is limited to 9 acres in 10 hours, or thereby; but in actual work it might not exceed 7 acres in that time.

Of all the reapers hitherto taken notice of in this paper, it is believed that not one of them was ever worked throughout a harvest. Even Smith's and Mann's machines, which were the most perfect, do not appear to have been worked beyond a few hours consecutively; their actual capabilities, therefore, seem never to have been properly tested.

The year 1826 may be held as an era in the history of this machine, by the invention, and the perfecting as well, of a really effective mechanical reaper. This invention is due to the Rev. Patrick Bell, now minister of the parish of Carmylie in Forfarshire. The principle on which its cutting operation acts is that of a series of clipping shears. When the machine had been completed, Mr Bell brought it before the Highland and Agricultural Society, who appointed a committee of its members to inspect its operation in the field, and to report. The trials and the report being

favourable, the Society awarded the sum of £50 to Mr Bell for his invention, and a correct working model of the machine was subsequently placed in the Society's Museum. The invention shortly worked its way to a considerable extent in Forfarshire; and in the harvest of 1834, the writer, in a short tour through that county, saw several of these machines in operation, which did their work in a very satisfactory manner. Dundee appears to have been the principal seat of their manufacture, and from thence they were sent to various parts of the country. It is known, also, that *four* of the machines were sent to the United States of America, and this circumstance renders it highly probable that they became the models from which the numerous so-called inventions of the American reapers have since sprung. At the great fair or exhibition held at New York in 1851, not fewer than six reapers were exhibited, all by different hands, and each claiming to be a special invention; yet, in all of them, the principal feature—the *cutting* apparatus—bears the strongest evidence of having been copied from Bell's machine. There are slight variations, as might naturally be expected, in the cutters, but the original type is evident throughout. It is remarkable, too, that in Hussey's reaper, which, by the American reports of the fair, appears to have been the first of the kind brought out in the Union, there is the closest possible resemblance to Bell's, the original; but, as we shall have occasion hereafter to notice, it is but an imperfect though cheap imitation.

Nothwithstanding the perfection of Bell's reaper, it has rather unaccountably been allowed by our agriculturists to fall into disuse, and only in a few cases have its operations been kept up to the present time. One of the most interesting of these is that of Mr J. Bell of Inch-Michael in the Carse of Gowrie, a brother of the inventor. Mr Bell has a strong natural bias towards *mechanics*, and during fourteen years, in which he has regularly worked his reaper, he has taken a particular pleasure in seeing it put in proper working order at the commencement of the harvest; so prepared, it is then managed with perfect success by any ploughman of ordinary intelligence. By these simple precautions, Mr Bell has been enabled in the most satisfactory manner to reap on an average four-fifths of all his grain crops every year; the remaining fifth, more or less, according to the season, being too much laid for the machine, has been reaped by the scythe—no sickle having been used on his farm during all this period. The expense of machine-reaping has, in this case, been found not to exceed 3s. 6d. per imperial acre. Under these favourable views of the efficiency and economy of Bell's reaper, a question naturally arises, What has been the cause of such a machine falling so much into disuse? One obvious reason is, that all the best reaping-machines herein

referred to may very appropriately be said to have appeared before their *time*—that is to say, before the subject on which they were to act had been prepared for their reception. In the first quarter of the present century, furrow-draining, levelling high ridges, and filling up the old deep intervening furrows, were only beginning to assume their due prominence in the practice of agriculture; and so long as these improvements remained in abeyance, the surface of the land was very ill suited for such operations as that of a reaping-machine. Hence serious obstacles were presented to its application; but as these are fast being removed, there is a prospect of a more successful application of machinery, of whatever kind, being now brought to bear upon the field operations of the farm.

Whatever be the causes that may have operated against the extension of Bell's machine, we have seen that, in the hands of a good manager, one of them has served well during a period of fourteen years, and it seems capable of serving at least fourteen more, thus holding out a strong recommendation to the re-adoption of it, or some other equally good or better, if such may be found. To enable our readers to form a just conception of the construction and principles of Bell's machine, and to compare it with those now being introduced after the American copy, the annexed plate is given, showing a full view, in perspective, of Bell's reaper in its most approved form. The machine consists, first, of an open carriage framework of carpentry about 4 feet wide, the same in length, and about 3 feet high, marked *a a a a* in Plate V. This is supported on two principal wheels *b b*, about 4 feet in diameter, and two minor wheels *c c*, 18 inches in diameter, supporting the forepart of the carriage, to the front bar of which the cutting apparatus is attached. The axle of the main wheels passes quite through the carriage-frame, and supports it by turning in bearings, fixed to the middle horizontal bars, on either side. On this axle is fixed a bevel wheel *e*, 20 inches in diameter, turning with the main wheels and axle, and gearing into the bevel pinion *f*, fixed upon the sloping shaft *g*, which, at its lower end, carries a short crank *h*. This last, by means of the connecting-rod *i*, gives the vibrating motion to the cutter-tail bar *k*, to which bar the tails of the movable blades of the series of shears are loosely jointed.

The bevel-wheel *e* gives motion also to the small sloping shaft *l*, through a pinion not seen in the figure; and at the upper end of this shaft, by means of the small mitre-wheels, motion is given to a small horizontal shaft *p*, on the end of which a combination of three bevel-wheels and clutch, at *p'*, gives motion to the first web-roller, making the web *o* (which is here represented as broken off to expose the parts below) revolve to right or left, as desired. The web, when in action, is stretched over the two rollers *n n*. The light iron bars *q q* serve to carry the revolving fly or vane

to collect and carry the cut corn to the web. The vane derives its motion from a pulley fixed on the extreme end of the small shaft *p*, another being fixed on the extremity of the axle of the vane; and a small band passing round these pulleys, completes the motion. The vane is readily adjustable to suit any height of grain, and also to distance horizontally, to suit the delivery of the cut grain upon the web. This machine is worked by two horses, pushing it before them by means of the pole *s*, to which they are yoked by the common draught-bars. In its original form, a castor or swivel-wheel was attached under the machine, and brought to bear up the hind-part of it from the ground, by a rack and pinion worked by a handle. The intention of this was to obviate a supposed difficulty in turning the machine. Experience, however, has shown that the supposition was groundless. The swivel-wheel has been laid aside; and as one of the main wheels necessarily required the convenience of being disengaged from the gearing that drives the cutter, &c., the same disengagement serves to make the machine turn with all requisite facility.

The cutter consists of a fixed bar of iron *r r*, 6 feet in length, so that it projects over and clears a passage for all the bearing wheels and other projecting points in the machine. The bar is strongly attached to the fore-part of the framework by two iron brackets, and to the bar are firmly bolted the 13 fixed blades of the shears. The 12 movable blades are likewise attached to the same bar, each upon a joint-bolt. Each of these last blades is prolonged backward in a tail-piece, till they rest in the vibrating bar *k*, where the extremity of each tail rests between two pegs, which serve as a secure but simple and loose joint for it. Such are the different motions of the machine, and, when in operation, the effects are as follows:—The main or driving wheels being nearly 4 feet in diameter, one turn of these carries the machine in its progressive motion over 12 feet of surface. The bevelled-wheel and pinion *e* and *f* being in the proportion of 6 to 1, the crank and cutter-tail bar will make six vibrations in the time that the machine moves over 12 feet; but as the movable blades of the shears cut both ways, they will each make 12 cuts in the same time, each cut extending to 12 inches forward; and as the cutting-blades are 14 inches long, the uncut corn can never reach the *root* or joint-end of the shears, to produce choking. The revolving vanes in front serve to catch hold of and retain the corn against the onward pressure of the cutter, but their chief duty is to assist in laying the cut corn upon the endless web. The duties of the web are very simple, being merely to convey the cut corn to right or left, and to deliver it upon the ground, which it does with a regularity perfectly sufficient for the purpose of being gathered into sheaves.

In the process of working this machine, Mr Bell's practice is to

employ *one* man driving and conducting the machine; 8 women are required to collect the cut corn into sheaves, and to make bands for these sheaves; 4 men to close and bind the sheaves, and 2 men to set them up in stooks—being in all fourteen pair of hands, besides the driver of the horses, whose time reckons along with them; and the work performed averages 12 imperial acres per day. These data have been obtained from fourteen years' experience of the machine, and have therefore a strong claim upon the consideration of the farmer. The expense in money for reaping by such a machine will of course vary a little with the rate of wages; but, on an average, it may be taken at three shillings and sixpence an acre, including the expense of food to the workers. This, in round numbers, may be taken at a saving of one-half the usual expense of reaping by hand, at the lowest calculation; and the saving on a farm where there might be 100 acres of cereal and leguminous crop would do more than cover the price of a machine of the best quality in two years.

The importation of two reaping-machines from America has already been adverted to, as also their resemblance in principle to that of Bell's, leading, when coupled with other circumstances, to the conclusion, that not only those two imported, but all the reaping-machines now used in the Union, are based upon the same principle which is the leading feature—the cutter—in Bell's. In the American machine, the framework is so constructed and arranged that the horses *draw* the machine, walking by the side of the standing corn, as in Mann's, and others already referred to; but that change in the application of the power, as well as the construction of the whole framework, are mere matters of detail, without at all touching the principles recognised by the Highland and Agricultural Society in the award given in favour of Mr Bell's machine. It must be observed, too, that the oldest of the American reapers—Hussey's—contains nothing beyond the cutters, and that is essentially Bell's, with this very unimportant difference, that the cutting-blades, instead of acting from centre-bolts, are fixed dead upon a vibrating bar, corresponding to the bar so named in the description of Bell's, and of course move along with that bar, producing that everyday form of shears—the parallel motion shears. The maker has stopt short at that point where all inventors in this field of mechanics have found their greatest difficulty—the collecting and delivering the corn after being cut; for in all attempts at machine-reaping, the cutting process seems to have presented little if any difficulty; but it was not until Bell's and Mann's machines came upon the field that anything appeared deserving the name of a collecting and delivering apparatus. Mr Hussey, it would appear, had met the same difficulty, but, taking a short method of obviating it, he gives forth his machine with the cutter only, leaving all the after-details to be per-

formed by manipulation. By thus leaving the machine in a half-completed state, he is obliged in most cases, it is understood, to employ besides the driver two men *upon* the machine, to collect and deliver. In consequence of these half-measures of construction, the framework and gearing of this and all the other American reapers are very simple, and, as a matter of course, very similar to the original, excepting such changes as are required to let the horse walk in front by the side of the standing corn.

M'Cormick's machine, which, on its first appearance in England, had the cutters nearly identical with the one above described, has latterly been fitted with one long straight-edged and finely-serrated cutter, giving apparently a new character to the machine, though in fact it is no more than engrafting a new idea upon the original—Bell's. Mr M'Cormick has also gone a step beyond his neighbour, Mr Hussey, by taking from our original also the revolving vanes in front for collecting and holding the corn to the cutter. By these means the machine is made more effective, and operates with the assistance of *one* man upon the machine besides the driver. In all other respects it is not sensibly different from the other. Of the other reapers incidentally alluded to as of American construction, and judging from the published figures of each, they stand—two with the revolving vanes, like M'Cormick's, and two without, like Hussey's. Of the actual performance of the two Transatlantic visitors little can yet be said, neither of them having yet performed a day's work in this country—and by that alone can their proper value be determined. The first is given out as capable of cutting 15 acres a-day, with two horses walking at the rate of 2¾ miles an hour. The second is warranted to the same extent, with the same power walking at the same rate. But these results, so far as this country is concerned, can only be of necessity the result of calculation, seeing they have not done a day's work; and as we have seen that Mr Bell's well-tested machine should, by calculation, cut 18 acres a-day, with two horses walking 2½ miles an hour, whereas in practice it can only accomplish 12 acres, it is not unreasonable to suppose a like shortcoming between calculation and practice, bringing the results, in the case of the Americans, down to 10 acres, or even less, as few farm-horses will be found to continue to walk even at 2½ miles an hour. The price of Hussey's machine is quoted by the makers at £21; that of M'Cormick at £30. It is difficult to see how such a difference of value can exist in two machines differing so little from each other in their general structure and performance.

A sketch has here been given of the progress, through half a century, of the attempts to establish an effective reaping-machine by British machinists; and it has been shown that the latest and most successful of them, though sanctioned and rewarded by the Highland and Agricultural Society, yet has, from some undefined

cause, been suffered to be almost neglected by both agriculturists and machinists; fortunately, however, a successful practice of fourteen years has amply established its true and valuable character. In this interim our American brethren have been, in the usual Western phrase, going ahead; and, amongst many subjects, with that also of the reaping-machine. Two of them, sent to the Exhibition, stirred up the whole agricultural body of Britain—aided greatly, no doubt, by the universal excitement under which the entire community then laboured. But however meritorious these reapers may have been, they still are but copies, and imperfect ones, of that machine which had previously acquired the highest degree of merit in this country. This claim is made, not with any view to disparage the exertions of the Americans, or to undervalue their mechanical productions—the importance of which, in all departments of the arts, is already known over the civilised world, but simply with the view of establishing a fact, and attributing priority of invention to the true author—a circumstance too often overlooked, especially in matters mechanical, where the original has not been covered by a patent.

Time alone can decide the question of ultimate success in this country. We have, on the one hand, the original form of our own countryman's invention satisfactorily surviving the test of fourteen years' practical operation, and, on the other, the general success which has attended the introduction of its imitation into the United States; but we cannot doubt that the operation of another harvest will go far to solve the point.

PROCEEDINGS IN THE LABORATORY.

By Thomas Anderson, M.D., Chemist to the Highland and Agricultural Society.

ON THE COMPOSITION OF SOME MANUFACTURED MANURES, AND OF DIFFERENT SORTS OF REFUSE FROM MANUFACTORIES USED AS MANURES.

The systematic works on Agriculture and Agricultural Chemistry are remarkably deficient in details of the analyses of manufactured manures. This deficiency I have endeavoured to supply, as far as regards superphosphate of lime, in a recent number of the *Transactions of the Highland and Agricultural Society;* and I propose now to communicate the results of a number of analyses, which have accumulated during the last year, of substances employed or proposed to be employed as manures, some being manufactured expressly for the purpose, and others being the refuse of different manufacturing operations.

I have had frequent occasion, in conversation with farmers, to

remark that manufactured manures are generally sold at prices much above their true value, when compared with what may be called the natural portable manures, such as guano, bones, and the like—a statement which will find abundant confirmation in the following pages. Many of the substances examined in the Laboratory, and many similar substances, would be valuable manures if they were sold at prices proportionate to the quantity of valuable substances which they contain; but in place of their price being regulated in this way, that of guano is taken as the standard for all such manures, and their price fixed just sufficiently much lower to induce the inconsiderate to purchase what appears to be a good bargain. It may be stated broadly that no manufactured manure is at all comparable, in point of value, to Peruvian guano, nor is any such likely to be produced; and this for the simple reason, that the substances valuable as constituents of a manure are applicable also to various other commercial purposes, and have a definite market value, below which they can only be depressed by the discovery of new and abundant sources from which they can be obtained.* These sources must even have the peculiarity of supplying the valuable constituents in a condition in which they cannot be easily or economically extracted in a state of purity; for if this be possible, they acquire a value for manufacturing purposes which would either divert them to other uses, or raise their prices above what the farmer could afford to pay. It is for this reason that guano is cheaper to the farmer than any other manure: he buys ammonia in it at a lower price than it can be obtained in any other form; and its lowness of price thus depends upon its existing in a state in which it cannot be *profitably* made available for any other purposes than those of a manure. The farmer will see, from this, how much he is interested in the discovery of new and abundant sources of ammonia, as the price of that article regulates, or ought to regulate, that of guano; and there can be no reasonable doubt that a large reduction in the price of ammonia would compel that of guano to fall also; and in this, as in many similar cases, the agriculturist is nearly as much interested in the progress of pure, as he is in that of agricultural chemistry.

The classification of manufactured manures is almost impossible, scarcely two of those obtained from different manufacturers being

* It is a common statement, among persons hostile to the movement which has been made, during the last few years, to place the principles of agriculture on a scientific basis, that the chemist has failed in supplying the farmer with a manure equal to guano. This is quite a mistake: the chemist can easily make such a manure; but the substances he requires to employ are so expensive that the mixture is more costly than guano. In the present state of the manufacturing arts, the demand for the valuable matters of manures is so great, and the supply so limited, that their price is kept above the point at which they can be economically employed for making manures.

similar in composition, and I must content myself with taking them in succession, without attempting any arrangement.

I shall select first, however, a substance sold under the name of *artificial guano*, which I consider to be of importance, as the name is an attractive one, and apt to mislead the farmer into the idea that he is purchasing a substance equally valuable with the natural manure. This substance was found to have the following composition :—

Water,	14.83
Organic matter and ammoniacal salts,	18.28
Phosphates,	13.83
Lime,	23.19
Sulphuric acid,	14.03
Carbonic acid,	8.15
Alkaline salts,	0.77
Sand,	6.92
	100.00
Ammonia,	0.58

This substance, in fact, scarcely differs in its composition from some of the samples of inferior superphosphate of which I gave the analyses in a previous number of the *Transactions*, and has obviously been prepared in a similar manner. I do not know at what price it was sold—probably, however, at £5 or £6; and if we calculate in the usual way of estimating the value of a guano, and allow the sum of 7s. 6d. for the sulphate of lime it contains, (which amounts to nearly one-fourth of its weight,) we shall find that it ought to be sold at about £1, 13s. At that price it would be a useful manure, but *it would be no cheaper than guano*, as it would have to be applied in a proportionably increased quantity.

Under the name of *bone manure*, I obtained, some time since, a quantity of a substance, which was found to be a very complex mixture of different substances, among which nitre formed a part. The composition was—

Water,	11.44
Organic matter,	16.75
Phosphate of lime,	6.42
Sulphate of lime,	29.51
Sulphate of magnesia,	10.48
Sulphate of potash,	4.60
Nitrate of potash,	3.82
Chloride of sodium,	9.76
Sulphuric acid,	4.09
Sand,	3.13
	100.00
Ammonia,	3.00

Estimating the ammonia, gypsum, phosphate, nitrate, and sulphate of potash, at their ordinary prices, the value of this substance should stand somewhere about £3, 10s., while I have reason to believe that its cost was much higher.

Another substance analysed in the laboratory, under the name of *Turnip Manure*, appeared to have been produced in some way from urine, apparently that of cows', but mixed probably with a small quantity of dissolved bones, and much gypsum and chalk. Its composition was—

Water,	11.013
Organic matter,	4.826
Peroxide of iron and alumina,	1.154
Phosphate of lime,	4.941
Sulphate of lime,	34.374
Carbonate of lime,	10.946
Carbonate of magnesia,	3.342
Chloride of sodium,	5.275
Sulphate of soda,	4.759
Sulphate of potash,	4.230
Sulphate of ammonia,	4.178
Silicious matter,	11.151
	100.189

Another substance, which was some time since imported from Denmark as a manure, and which, so far as I could understand, was a natural production, and was stated to have been largely exported to France and other countries, gave the following results:—

Sand,	15.89
Peroxide of iron and alumina,	3.55
Carbonate of lime,	19.69
Carbonate of magnesia,	1.18
Potash,	0.39
Soda,	0.46
Sulphuric acid,	0.34
Phosphoric acid,	1.51
Organic matter,	15.63
Water,	41.36
	100.00
Ammonia,	0.78

In appearance this substance was a very wet brownish substance, and did not differ much from some sorts of peat, which it likewise considerably resembles in composition. Its valuable constituents are much too trifling in proportion to make it likely that it can be advantageously imported into this country. Excepting the 20 per cent of carbonate of lime, and the small quantities of phosphoric acid, potash, and ammonia, it contains nothing valuable; and even these can undoubtedly be obtained more cheaply from other sources than they could be from this substance.

I shall quote only one analysis of a similar kind, and it is that of a manure imported from France, which shows the good effects derived from the analyses of such substances. Its composition was—

Water,	50.69
Organic matter,	18.84
Silica,	21.47
Phosphates, containing peroxide of iron,	3.92
Lime,	3.24
Magnesia,	0.14
Potash,	0.12
Soda,	0.76
Sulphuric acid,	0.63
Chlorine,	trace
	99.81
Ammonia,	0.98

As may readily be understood, I reported unfavourably of a manure containing more than half its weight of water; and the consequence was, that at an after period another sample was sent as being the manure *now* manufactured, the analysis of which gave the following results:—

Water,	6.00
Organic matter,	49 82
Peroxide of iron and alumina,	3.63
Lime,	4.83
Magnesia,	0.63
Potash,	0.44
Soda,	0.91
Sulphuric acid and chlorine,	3.32
Sand,	30.43
	100.01
Ammonia,	1.77

No information was supplied as to the mode of manufacture or source of this manure. I conceive it, however, to be a sort of poudrette, and its value is probably equal to that of most of the samples offered for sale. In the percentage of nitrogen, it comes near the Montfauçon poudrette, according to Boussingault's analysis of that substance.

It is pleasing to turn from these substances to some other manufactured manures of real value. Unfortunately, however, these are the exception, at least they have been in the case of those manures which have come under my hands, and I fear are so in most instances.

I shall select a substance sold under the name of *Ammoniacal phosphate manure*, which, from its properties, I imagine must have been made by dissolving bones with a small quantity of sulphuric acid, mixing with the ammoniacal liquor of the gas-works, and evaporating to dryness, or, at least, in some similar manner.

Water,	19.185
Organic matter,	9.198
Phosphate of lime,	15.547
Sulphate of ammonia,	23.096
Sulphate of magnesia,	3.874
Sulphate of lime,	6.552
Sulphate of potash,	0.718
Sulphate of soda,	1.514
Carbonate of lime,	3.466

Peroxide of iron,	5.849
Alumina,	3.961
Sand,	10.236
	99.836

A ton of this substance contains therefore nearly $\frac{1}{4}$ of a ton of sulphate of ammonia, and nearly $\frac{1}{6}$ of a ton of actual phosphate of lime. If a ton of sulphate of ammonia be bought, therefore, for £12, the value of the quantity contained in one ton of the manure ought to be nearly £3; and practically it would be more, because the ton of commercial sulphate of ammonia cannot be supposed to be perfectly pure, but must always contain a certain quantity of moisture and other impurities. The phosphates are worth about £1, 2s.; and allowing 8s. for the value of the other constituents, we must estimate this manure as worth fully £4, 10s. per ton.

The following analysis gives the composition of *Flesh manure*, prepared by Messrs Turnbull & Co. of Glasgow, which, it will be observed, is greatly superior to the South American substance of the same sort, of which I published an analysis in the Transactions of the Society some time since:—

Water,	12.17
Organic matter,	78.44
Phosphates,	3.82
Alkaline salts,	3.64
Sand,	1.93
	100.00
Ammonia,	11.20

As a source of nitrogen, then, this manure stands next to Peruvian guano; but it supplies a greatly smaller quantity of phosphates than that substance, a matter which ought not to be neglected where it is to be employed.

Silicate of Potash.—Silicates of potash and soda were proposed some years ago as manures, with the special object of supplying silica to the plant in a soluble condition, but I believe with very indifferent success. Most of the experimenters who have used them have found no results whatever; and those instances in which an effect was produced, are far from being conclusive. I am not aware of the sources or mode of preparation of the silicates employed in the published experiments, but the following analysis of what has been sold as silicate of potash may serve to put experimenters on their guard:—

Insoluble silica,	53.32
Soluble silica,	8.62
Potash,	12.77
Peroxide of iron and alumina,	1.99
Lime,	0.29
Magnesia,	0.13
Chloride of sodium,	0.78
Sulphuric acid,	0.35

Carbonic acid,	1.80
Water,	19.43
	99.49

Silicate of potash ought to be entirely soluble in water; or, in other words, the whole of the silica contained in this substance, amounting to 61.92, ought to have been soluble; while the analysis shows that little more than one-eighth of the whole, or 8.62, dissolved in water. In the quantities in which silicate of potash has hitherto been employed for experiment, (1 or 2 cwt.) it will be easily understood that the 9 or 18 lb. of soluble silica could have little effect upon the acre. I confess I am not sanguine as to the effects to be derived from the use of carefully prepared silicates of potass and soda; but it is certain that they have not yet, so far as I know, been experimented with in sufficient detail to admit of our drawing accurate conclusions regarding the benefits to be derived from their use.

REFUSE OF MANUFACTORIES.

I shall divide the samples of refuse I have examined into those which are valuable respectively for their ammonia, their potash, and their phosphate of lime.

Those of the first class are comparatively few in number, and, generally speaking, do not contain that element in large quantity, and are not for a moment to be compared to guano as a source of nitrogen. They are mostly substances of vegetable or animal origin, and contain also a certain proportion of phosphates, although not sufficiently large to make them important on that account.

Sugar Scum.—Under this name I received some time since, for analysis, a quantity of a thick moist brown cake, which is the residue obtained on filtering syrup in the sugar refineries, and contains a quantity of the albuminous matters which have been present in the unrefined sugar. It contained—

Water,	48.44
Organic matter,	39.10
Phosphates,	3.99
Lime,	3 41
Magnesia,	0.19
Alkaline salts,	1.64
Sand,	3.23
	100.00
Ammonia,	2.23

Here, notwithstanding the immense quantity of water, we have an amount of ammonia = 2.23 per cent; or more correctly speaking, an amount of nitrogenous constituents capable of yielding that quantity, as well as nearly 4 per cent of phosphates. If sold at a cheap rate, therefore, this substance would probably prove useful to the farmer. Its utility, however, is entirely a matter of price.

Cocoa-Bean Husk.—In the preparation of the cocoa-bean, a quantity of husk is separated, of which the following analysis was made in the laboratory:—

Water,	9.60
Nitrogen,	2.31
Sand,	9.55
Phosphates,	2.60
Other inorganic matters,	4.88
Organic matter,	71.06
	100.00

In point of nitrogen and phosphates, the results of this analysis do not differ much from those of the sugar scum. It is not likely, however, that the bean husks will prove so useful as a manure, because they are much less decomposable, and would yield their valuable constituents much more slowly to the plant; but when a slowly-acting manure is desired, benefit would no doubt be derived from it. The application, however, would require to be large, and I do not see how anything could be done with less than from quarter a ton to half a ton per acre.

Horn Dust.—Pure horn-shavings should consist entirely of nitrogenous matters; but coming generally from comb manufactories, where bone and other materials are employed, and being carelessly preserved, they often are mixed with much impurity. The only analysis of such a substance which has been made in the laboratory was found to have the following composition:—

Organic matters,	50.74
Phosphoric acid,	3.54
Soluble inorganic matters, containing much carbonate of lime,	19.84
Sand,	25.88
	100.00

Pure horn-shavings are a valuable manure, but of course this substance is of very inferior quality.

Of the manures containing potash, the most important is the impure sulphate obtained during the preparation of iodine from kelp. Of this substance a considerable number of samples have been analysed in the laboratory, of which I shall select two as examples of the usual composition it possesses.

	No. I.	No. II.
Water,	12.294	19.49
Organic matter,	0.752	0.36
Sulphate of potash,	40.539	35.15
Chloride of potassium,	13.915	5.27
Carbonate of potash,	3.420	4.60
Chloride of sodium,	28.319	33.29
Lime,	—	0.31
Magnesia,	0.016	0.10
Peroxide of iron,	0.352	—
Sand,	0.507	0.51
	100.114	99.08

In these two specimens there is a difference of no less than 13 per cent in the proportion of potash salts, (including the sulphate of potash, chloride of potassium, and carbonate of potash;) but I have seen samples differing still more in the proportion they contain, and one has been analysed containing only 12.75 per cent of sulphate of potash.

The only other substance from which potash can be obtained for use as a manure is the refuse from the manufacture of prussiate of potash, which has occasionally been sold to the farmers under the name of *Animal charcoal.* Two analyses of this substance have been made in the laboratory, of the refuse from the works ot Messrs Millar and Arthur, Leith, and of that from a work at Battersea, London.

	No. I.	No. II.
Sulphate of potash,	12.62	10.73
Chloride of potassium,	0.20	—
Sulphate of soda,	—	1.26
Chloride of sodium,	1.10	—
Sulphate of lime,	0.89	8.78
Phosphate of lime,	—	0.95
Carbonate of lime,	5.15	—
Carbonate of magnesia,	0.98	1.71
Oxide and carbonate of iron,	11.17	18.78
Alumina,	3.35	—
Silica,	10.53	13.74
Carbonaceous matter,	28.42	15.26
Water,	25.50	28.91
	99.91	100.12

At a moderate price these substances might be usefully employed as a source of potash. Their employment, however, should be cautious, because a considerable part of the iron which they contain is in the state of protoxide, the application of which to land is generally far from being advantageous; and it should never be used until it has been well exposed to the air, to bring it into the state of peroxide.

Of substances rich in phosphates, I shall content myself with one example, and this is the refuse bone-charcoal of the sugar-refiners. After being frequently heated, so large a quantity of its charcoal is expelled that it no longer serves to decolorise the syrup of the refiners, and it is then sold as a manure. It has been frequently employed for the purpose, but I do not recollect having seen any analysis of it, so that the following two are not without interest:—

	No. I.	No. II.
Water,	11.62	0.14
Phosphate of lime,	71.10	75.81
Charcoal,	2.36	13.08
Sand,	1.84	1.64
Other matters, principally carbonate of lime,	13.08	9.33
	100.00	100.00

I believe the usual price at which this refuse is sold is about £4 per ton. A very simple calculation will, however, show that the phosphate of lime they contain is worth fully more than that sum. No. II, in fact, is worth above £5 per ton. In most instances this substance is bought without analysis, and in that case no prudent farmer would give above £4 per ton for it, as it might easily happen that, even where unadulterated, its value might not be higher than that sum.

I shall not at present bring forward any further analyses of manufactured or refuse manures, but shall from time to time present such as occur in the course of laboratory work, so as to enable the farmer to have a general idea of the substances current in the manure market, which, I have had occasion to observe, are frequently altering in nature and value.

ON THE COMPOSITION AND COMPARATIVE FEEDING VALUES OF TURNIPS GROWN UNDER DIFFERENT CIRCUMSTANCES AND IN DIFFERENT LOCALITIES.

Continued from No. XXXIII., p. 59.

No. 21.

White Globe Turnip, manured with 4 cwt. Guano, and 5 cwt. Horn-dust.

Pectic acid,	48.0
Ash,	13.2
Prot. compounds, containing 3.6 N.,	22.9
Woody fibre,	207.9
Total fibre,	292.0
Water,	9,079.0
Oil,	29.0
Prot. compds, containing 22.9 N.,	145.4
Sugar, gum, &c.,	454.6
	10,000.0

Ash,	76.0
Phosphates,	17.4
Phosphoric acid,	2.9

No. 22.

White Globe Turnip. manured with 5 cwt. Horn-dust, and 6 cwt. Rape-dust.

Pectic acid,	26.1
Ash,	7.7
Prot. compounds, containing 1.76 N.,	11.2
Woody fibre,	129.0
Total fibre,	174.0
Brought forward,	174.0
Water,	9,198.3
Oil,	10.8
Prot. compnds, containing 26.06 N.,	165.9
Gum, sugar, &c.,	451.0
	10,000.0

Ash,	73.1
Phosphates,	10.8
Phosphoric acid,	0.8

No. 23.

White Globe Turnip, manured with 6 cwt. Rape-dust, and 3 cwt. Dissolved Bones.

Pectic acid,	80.0
Ash,	14.1
Prot. compounds, containing 3.8 N.,	24.1
Woody fibre,	192.8
Total fibre,	261.0
Water,	8,997.0
Oil,	19.7
Prot. compnds, containing 26.2 N.,	166.4
Sugar, gum, &c.,	555.9
	10,000.0

Ash,	95.0
Phosphates,	20.7
Phosphoric acid,	1.5

No. 24.

White Globe Turnip, manured with 6 cwt. Pigeon's Dung, and 2 cwt. Sulphate of Ammonia.

Pectic acid,	36.0
Ash,	15.0
Prot. compounds, containing 5.3 N.,	33.6
Woody fibre,	224.4
Total fibre,	309.0
Water,	8,839.0
Oil,	25.0
Prot. compnds., containing 38.2 N.,	242.6
Sugar, gum, &c.,	584.4
	10,000.0

Ash,	110.0
Phosphates,	24.7
Phosphoric acid,	1.1

No. 25.

White Globe Turnip, manured with 4 cwt. Dissolved Bones, and 12 cwt. Animal Charcoal.

Pectic acid,	23.8
Ash,	13.8
Prot. compounds, containing 3.2 N.,	20.3
Woody fibre,	258.5
Total fibre,	316.4
Water,	9,044.0
Oil,	34.2
Prot. compds., containing 26.3 N.,	167.5
Sugar, gum, &c.,	437.9
	10,000.0

Ash,	81.3
Phosphates,	17.3
Phosphoric acid,	3.8

SECOND SERIES.

ANALYSES OF TURNIPS GROWN IN DIFFERENT LOCALITIES, AND WITH FARM-YARD MANURE AND GUANO.

The object of this series of analyses was to determine the comparative feeding values of turnips grown with farm-yard manure and guano; and to investigate the correctness of the impression which prevails on the part of some feeders that turnips grown with the latter manure are inferior in nutritive value. The turnips were grown under similar circumstances, and were sent to the Laboratory when they had arrived at full maturity. The different specimens have been grown in East Lothian, Perthshire, and in different parts of Mid-Lothian. Those from East Lothian were grown on a true turnip soil of fine quality; the others are on the ordinary soils; and those of Mr M'Lean, Braidwood, are grown in a very high-lying and exposed district, and on a soil which has been recently improved.

The last two analyses were intended to determine the values of turnips which had been stored in autumn, and those pulled in early spring.

No. 1.

White Globes from Mr Waugh, Eweford, East Lothian. Dung.

Pectic acid,	52.2
Ash,	12.5
Protein compounds, containing 3.9 N.,	24.7
Woody fibre,	194.6
Total fibre,	284.0
Water,	9,141.0
Sulphur,	1.8
Oil,	11.3
Protein compounds, containing 17.5 N.,	111.1
Sugar, gum, &c.,	450.8
	10,000.0

Ash,	91.0
Phosphates,	16.8
Phosphoric acid,	0.9

No. 2.

White Globes, Mr Waugh. Dung and Guano.

Pectic acid,	75.8
Ash,	13.6
Protein compounds, containing 3.02 N.,	19.2
Woody fibre,	189.3
Total fibre,	297.9
Water,	9,220.0
Sulphur,	4.0
Oil,	11.6
Protein compounds, containing 1.564 N.,	99.6
Sugar, gum, &c.,	366.9
	10,000.0

Ash,	83.8
Phosphates,	14.5
Phosphoric acid,	1.7

No. 3.

White Globes, Mr Waugh. Guano alone.

Pectic acid,	41.3
Ash,	10.7
Protein compounds, containing 2.1 N.,	13.3
Woody fibre,	197.2
Total fibre,	262.5
Water,	9,285.7
Oil,	22.7
Protein compounds, containing 18.0 N.,	114.6
Sugar, gum, &c.,	314.5
	10,000.0

Ash,	83.0
Phosphates,	15.4
Phosphoric acid,	0.9

No. 4.

Purple-top Yellows, Mr Waugh. Dung.

Pectic acid,	15.6
Ash,	14.3
Protein compounds, containing 4.0 N.,	25.4
Woody fibre,	260.7
Total fibre,	316.0
Water,	9,120.0
Sulphur,	2.5
Oil,	10.3
Protein compounds, containing 13.6 N.,	86.3
Sugar, gum, &c.,	464.9
	10,000.0

Ash,	63.0
Phosphates,	10.3
Phosphoric acid,	traces.

No. 5.

Purple Top Yellows, Mr Waugh. Dung and Guano.

Pectic acid,	62.9
Ash,	8.3
Protein compounds, containing 2.9 N.,	18.4
Woody fibre,	183.4
Total fibre,	273.0

Water,	8,972.0
Sulphur,	3.5
Oil,	15.9
Protein compounds, containing 22.9 N.,	139.7
Sugar, gum, &c.,	595.9
	10,000.0

Ash,	64.0
Phosphates,	17.7
Phosphoric acid,	traces.

No. 6.

Purple Top Yellows, Mr Waugh. Guano.

Pectic acid,	37.1
Ash,	11.3
Protein compounds, containing 2.7 N.,	17.1
Woody fibre,	238.5
Total fibre,	304.0

Water,	9,250.0
Sulphur,	2.5
Oil,	16.3
Protein compounds, containing 14.0 N.,	88.9
Sugar, gum, &c.,	338.3
	10,000.0

Ash,	64.0
Phosphates,	8.1
Phosphoric acid,	0.2

No. 7.

White Globes, from the Cairnies, Perthshire. Dung.

Pectic acid,	38.5
Ash,	11.3
Protein compounds, containing 2.89 N.,	18.4
Woody fibre,	219.8
Total fibre,	288.0

Water,	9,143.3
Oil,	17.2
Protein compounds, containing 7.66 N.,	48.7
Gum, sugar, &c.,	502.8
	10,000.0

Ash,	62.10
Phosphates,	12.41
Phosphoric acid,	0.06

No. 8.

White Globes, from the Cairnies, Perthshire. Guano.

Pectic acid,	21.1
Ash,	9.8
Protein compounds, containing 3.68 N.,	23.4
Woody fibre,	234.7
Total fibre,	289.0

Water,	9,140.2
Oil,	13.5
Protein compounds, containing 19.98 N.,	127.2
Gum, starch, &c.,	430.1
	10,000.0

Ash,	81.97
Phosphates,	13.32
Phosphoric acid,	0.12

No. 9.

White Globes, from Mr Dickson, Saughton Mains, Mid-Lothian. Dung.

Pectic acid,	31.0
Ash,	13.0
Protein compounds, containing 3.2 N.,	20.0
Woody fibre,	252.0
Total fibre,	316.0

Water,	9,037.0
Sulphur,	6.19
Oil,	33.0
Protein compounds, containing 20.4 N.,	130.0
Sugar, gum, &c.,	477.81
	10,000.00

Ash,	61.0
Phosphates,	17.0
Phosphoric acid,	0.3

No. 10.

White Globes, from Mr Dickson. Dung and Guano.

Pectic acid,	64.0
Ash,	13.9
Protein compounds, containing 3.18 N.,	20.0
Woody fibre,	236.1
Total fibre,	334.0

Water,	9,072.0
Sulphur,	4.8
Oil,	24.0
Protein compounds, containing 17.07 N.,	110.0
Sugar, gum, &c.,	455.2
	10,000.0

Ash,	64.0
Phosphates,	14.0
Phosphoric acid,	0.1

No. 11.

Swedes, from Mr Gibson, Woolmet, Mid-Lothian. 20 loads Dung, and 3 cwt. Guano.

Ash,	19.7
Protein compounds, containing 3.9 N.,	24.7
Woody fibre,	322.6
Total fibre,	367.0

Water,	9,243.0
Protein compounds, containing 11.3 N.,	71.8
Sugar, gum, &c.,	318.2
	10,000.0

Ash,	60.0
Phosphates,	13.2
Phosphoric acid,	traces.

No. 12.

Swedes, from Mr Gibson. 6 cwt. Guano.

Ash,	22.0
Protein compounds, containing 3.8 N.,	14.1
Woody fibre,	326.4
Total fibre,	362.5

Water,	9,383.0
Protein compounds, containing 4.3 N.,	37.3
Sugar, gum, &c.,	217.2
	10,000.0

Ash,	76.0
Phosphates,	12.6
Phosphoric acid,	traces.

No. 13.

Swedes from Mr M'Lean, Braidwood, Mid-Lothian. 40 *cubic yards Dung.*

Pectic acid,	13.98
Protein compounds, containing 1.55 N.,	9.87
Woody fibre, &c.	275.13
Total fibre,	298.98
Water,	9,054.81
Sulphur,	4.47
Oil,	27.86
Protein compounds, containing 27.86 N.,	177.44
Gum, sugar, &c.,	436.44
	10,000.00

Ash, . . . 59.56

No. 14.

Swedes, Mr M'Lean. 29 *cubic yards Dung and* 3 *cwt. Guano.*

Water,	8,952.0
Sulphur,	6.2
Oil,	24.2
Protein compounds, containing 36.8 N.,	233.6
Sugar, gum, &c.,	784.0
	10,000.0

Ash,	67.0
Phosphates,	19.6
Phosphoric acid,	0.7

No. 15.

Green Top Globes, Mr M'Lean. 40 *cubic yards Dung.*

Pectic acid,	11.97
Protein compounds, containing 1.37 N.,	8.72
Woody fibre, &c.,	269.74
Total fibre,	290.43
Brought forward,	290.43
Water,	9,219.75
Sulphur,	3.33
Oil,	31.14
Protein compounds, containing 25.23 N.,	160.70
Gum, sugar, &c.,	294.65
	10,000.00

Ash, . . . 76.42

No. 16.

Swedes, from the Right Hon. Lord Kinnaird, stored in November 1850.

Pectic acid,	35.3
Ash,	15.3
Protein compounds, containing 4.24 N.,	27.0
Woody fibre,	265.0
Total fibre,	342.6
Water,	9,253.8
Oil,	12.7
Protein compounds, containing 9.1 N.,	57.7
Gum, sugar, &c.,	333.2
	10,000.0

Ash,	56.50
Phosphates,	10.56
Phosphoric acid,	0.11

No. 17.

Swedes, from Right Hon. Lord Kinnaird, pulled in February 1851.

Pectic acid,	59.1
Ash,	15.4
Protein compounds, containing 2.06 N.,	13.1
Woody fibre,	234.6
Total fibre,	322.2
Water,	9,300.3
Oil,	9.2
Protein compounds, containing 6.21 N.,	39.5
Gum, sugar, &c.,	328.8
	10,000.0

Ash,	56.00
Phosphates,	6.02
Phosphoric acid,	0.09

THIRD SERIES.

TURNIPS GROWN ON DIFFERENT KINDS OF SOIL ON THE PROPERTY OF THE RIGHT HON. LORD KINNAIRD, IN PERTHSHIRE.

This series of analyses was undertaken with the view of ascertaining the value of turnips grown on soils of different qualities. The turnips were all treated in exactly the same manner in regard to manuring, &c., but were grown on different soils. The clay land is the heavy carse clay of the Carse of Gowrie, so celebrated for the excellence of the wheat crops which it produces. The hill land (as it is called in the district) is a light loam, which prevails on the high ground; and this black land lies in the junction of the clay and hill lands, and partakes of the characters of both. The hill land is believed in the district to produce turnips of decidedly superior quality to the other two.

No. 1.

Swedes, grown on Clay land.
Crop 1849.

Pectic acid,	55.0
Ash,	14.2
Protein compounds, containing 2.9 N.,	18.5
Woody fibre,	205.3
Total fibre,	293.0
Water,	9,058.0
Sulphur,	2.9
Oil,	35.6
Protein compounds, containing 12.9 N.,	81.5
Gum, starch, &c.,	529.0
	10,000.0

Ash,	65.0
Phosphates,	16.3
Phosphoric acid,	0.5

No. 2.

Swedes, grown on Black land.
Crop 1849.

Pectic acid,	18.5
Ash,	11.7
Protein compounds, containing 4.0 N.,	25.4
Woody fibre,	227.4
Total fibre,	283.0
Brought forward,	283.0
Water,	8,978.0
Sulphur,	2.9
Oil,	26.0
Protein compounds, containing 14.2 N.,	89.5
Gum, starch, &c.,	620.6
	10,000.0

Ash,	56.0
Phosphates,	17.6
Phosphoric acid,	0.5

No. 3.

Swedes grown on Hill land.
Crop 1849.

Pectic acid,	2.9
Protein compounds, containing 1.70 N.,	10.8
Woody fibre,	331.8
Total fibre,	345.5
Water,	8,712.3
Sulphur,	4.2
Oil,	54.9
Protein compounds, containing 26.79 N.,	170.6
Gum, starch, &c.,	712.5
	10,000.0

Ash,	57.6
Phosphates,	15.9
Phosphoric acid,	0.6

No. 4.

Swedes, grown on Clay land. Crop 1850.

Protein compounds, containing 3.7 N.,	23.5
Ash,	15.4
Fibre, &c.,	266.1
	305.0
Water,	9,273.0
Protein compounds, containing 8.6 N.,	54.6
Sugar, gum, &c.,	367.4
	10,000.0

Ash,	51.0
Phosphates,	9.6
Phosphoric acid,	traces.

No. 5.

Swedes, grown on Black land. Crop 1850.

Protein compounds, containing 4.0 N.,	35.4
Ash,	19.3
Fibre, &c.,	230.3
	275.0
Water,	9,278.0
Protein compounds, containing 5.9 N.,	37.4
Sugar, gum, &c.,	409.6
	10,000.0

Ash,	52.0
Phosphates,	9.0
Phosphoric acid,	traces.

No. 6.

Swedes, grown on Hill land. Crop 1850.

Protein compounds, containing 4.5 N.,	28.5
Ash,	9.5
Fibre, &c.,	261.0
	299.0
Water,	9,268.0
Protein compounds, containing 10.2 N.,	64.8
Sugar, gum, &c.,	368.2
	10,000.0

Ash,	70.0
Phosphates,	9.8
Phosphoric acid,	0.4

No. 7.

Aberdeen Yellows, grown on Clay land. Crop 1849.

Pectic acid,	60.8
Ash,	12.4
Protein compounds, containing 3.57 N.,	22.7
Woody fibre,	179.1
Total fibre,	275.0
Water,	9,119.5
Sulphur,	5.5
Oil,	25.4
Protein compounds, containing 15.88 N.,	101.1
Gum, starch, &c.,	473.5
	10,000.0

Ash,	60.4
Phosphates,	16.2
Phosphoric acid,	1.1

No. 8.

Aberdeen Yellows, grown on Black land. Crop 1849.

Pectic acid,	32.1
Ash,	18.6
Protein compounds, containing 3.8 N.,	24.2
Woody fibre,	237.1
Total fibre,	312.0
Water,	9,047.8
Sulphur,	2.6
Oil,	17.7
Protein compounds, containing 13.7 N.,	87.5
Gum, starch, &c.,	532.4
	10,000.0

Ash,	69.6
Phosphates,	16.7
Phosphoric acid,	0.2

No. 9.

Aberdeen Yellows, grown on Hill land. Crop 1849.

Pectic acid,	44.6
Ash,	13.7
Protein compounds, containing 3.9 N.,	24.8
Woody fibre,	234.9
Total fibre,	318.0
Water,	9,057.8
Sulphur,	2.8
Oil,	44.1
Protein compounds, containing 24.4 N.,	155.4
Gum, starch, &c.,	421.9
	10,000.0

Ash,	64.9
Phosphates,	13.3
Phosphoric acid,	2.8

No. 10.

Aberdeen Yellows, grown on Clay land. Crop 1850.

Ash,	13.4
Protein compounds, containing 3.04 N.,	19.3
Fibre, &c.,	251.3
Total fibre,	284.0
Brought forward,	284.0
Water,	9,426.3
Protein compounds, containing 7.84 N.,	49.9
Gum, sugar, &c.,	239.8
	10,000.0

Ash,	69.62
Phosphates,	6.81
Phosphoric acid,	0.87

No. 11.

Aberdeen Yellows, grown on Black land. Crop 1850.

Ash,	16.3
Protein compounds, containing 2.89 N.,	18.4
Woody fibre,	335.4
	370.1
Water,	9,059.0
Protein compounds, containing 13.81 N.,	87.9
Gum, oil, sugar, &c.,	483.0
	10,000.0

Ash,	199.00
Phosphates,	12.17
Phosphoric acid,	0.06

No. 12.

Aberdeen Yellows, grown on Hill land. Crop 1850.

Ash,	13.6
Protein compounds, containing 3.37 N.,	21.4
Woody fibre, &c.,	249.0
	284.0
Water,	9,399.3
Protein compounds, containing 12.0 N.,	76.4
Gum, sugar, &c.,	240.3
	10,000.0

Ash,	38.03
Phosphates,	12.00
Phosphoric acid,	1.42

FOURTH SERIES.

YELLOW TURNIPS GROWN AT MILLHILL WITH FARMYARD MANURE AND DIFFERENT AUXILIARY MANURES.

In this series of analyses we have the results of some very interesting experiments made on Lord Kinnaird's farm of Millhill. The different turnips were all manured with 16 loads of farmyard manure, and had, in addition, quantities of different auxiliary manures. The first Table gives the names of these substances, their cost, and the increase due to their employment. The analyses made were confined to the determination of the amount of water, ash, and protein compounds; and their results are given in a tabular form in Table II. No analyses were made of Nos. 4 and 5, as the gain was not equal to the cost of the manures.

Table I.—(*Fourth Series.*)

Table of the Manures applied to the Yellow Turnips on the Farm of Millhill, on Lord Kinnaird's Property; with the Expense and Produce per acre.

Crop 1850.

No.	Farmyard manure.	Cost.	Auxiliary Manures.	Cost.	Total cost.	Produce.	Gain.
	loads	L.			L. s	tons cwt lb	tons cwt lb
0	16	4	...	...	4 0	24 0 0	...
1	...	...	4 cwt. White's manure,	24/	5 4	28 5 80	4 5 80
2	...	...	2 cwt. guano, and 2 cwt. salt,	22/	5 2	28 15 80	4 15 80
3	...	...	3 cwt. guano,	30/	5 10	27 2 95	3 2 96
4	...	...	3 cwt. Baillie's B. manure,	24/	5 4	25 18 64	1 18 64
5	...	...	3 cwt. Coprolite,	24/	5 4	25 0 0	1 0 0
6	...	...	3 cwt. London Manure Co.'s manure,	24/	5 4	27 14 32	3 14 32
7	...	...	4 cwt. superphosphate,	24/	5 4	26 7 16	2 7 16
8	...	...	3 cwt. guano and 1 cwt. superphosphate, diluted with 200 gallons water,	42/	6 2	27 4 32	3 4 32
9	...	...	3 cwt. superphosphate, diluted with 200 gallons of water,	36/	5 16	27 15 80	3 15 80

Table II.—(*Fourth Series.*)

Tabular View of the quantities of Water, Ash, Protein Compounds, Nitrogen, and other Constituents contained in 10,000 parts of the different Turnips grown at Millhill.

Number.	Water.	Ash.	Protein Compounds.	Other Constituents, (Fibre, Sugar, &c.)	Nitrogen.
0	9327.0	39.6	83.8	549.6	13.2
1	9387.0	67.0	63.5	482.5	10.0
2	9411.0	55.0	68.5	465.5	10.8
3	9345.0	58.0	82.5	514.5	13.0
6	9285.0	76.0	95.8	543.2	15.1
7	9243.0	59.0	73.0	625.0	11.5
8	8862.0	75.0	117.4	945.0	18.5
9	9509.0	56.2	41.3	399.5	6.5

No analyses were made of Nos. 4 and 5, the gain not being sufficient to pay the expense of the manure.

Table III.

TABLE III.—(*First Series.*)

TABULAR VIEW of the QUANTITIES of WATER, NITROGEN, PHOSPHATES, and PHOSPHORIC ACID, in 10,000 Parts of each of the Turnips Analyzed.

WHITE GLOBES, grown by Mr FINNIE, Swanston.

No.	Manured with	Water.	Nitrogen. In Fibre.	Nitrogen. In Juice.	Phosphates.	Phospho-ric Acid.
1	6 cwt. Ichaboe guano, .. .	9364.0	3 70	11.20	13.50	0.80
2	6 cwt. guano, ...	9237.3	1.12	15.07	11.70	0.30
3	Do.	9369.0	4.30	10.50	12.30	1.00
4	Do.	9318.0	4.20	13.10	12.00	0.10
5	15 cwt. horn dust, ...	9102.0	4.00	22 50	18.00	0.17
6	6 cwt. dissolved bones, ...	9273.0	3.60	19.70	17.00	0.70
7	20 bushels bone dust, ...	9313.0	4.20	15.10	14.60	0.60
8	10 cwt. rape dust, ...	8987.0	4.10	29.10	17.20	0.70
9	6 cwt. superphosphate of lime, ..	9469.0	3.25	20.80	9.20	1.60
10	10 cwt. poppy cake, ...	9427.0	3.50	17.80	11.70	0.20
11	30 cwt. animal charcoal, ...	9355.0	3.10	24.30	14.10	[illegible]
12	3 cwt. guano, and 3 cwt. dissolved bones,	9233.0	4.40	23.60	15.00	1.00
13	3 cwt. guano, and 3 cwt. superphosphate,	9324.0	3.70	16.80	12.70	1.20
14	4 cwt. guano, and 3 cwt. rape dust, ..	9346.0	5.20	21.00	16.80	1.20
15	4 cwt. guano, and 3 cwt. poppy cake, ..	9479.0	3.60	11.80	10.00	0 50
16	4 cwt. guano, and 3 cwt. bone dust, ..	9145.0	3.10	23.80	17.50	2.00
17	2 cwt. sulphate of ammonia, and 3 cwt. bone dust, ...	9494.0	5.60	8.20	10.00	0.30
18	2 cwt. sulphate of ammonia, and 2 cwt. dissolved bones, ...	9193.0	3.57	19.11	15.27	2.77
19	2 cwt. sulphate of ammonia, and 3 cwt. rape dust, ...	9145.0	4.80	18.40	18.40	1.60
20	2 cwt. sulphate of ammonia, and 12 cwt. animal charcoal, ...	9409.0	3.70	11.90	12.00	0.40
21	4 cwt. guano, and 5 cwt. horn dust, ..	9079.0	3 60	22.90	17.40	2.90
22	5 cwt. horn dust, and 6 cwt. rape dust,	9198.3	1.76	26.06	10.80	0.80
23	6 cwt. rape dust, and 3 cwt. dissolved bones, ...	8997.0	3.80	26 20	20.70	1.50
24	5 cwt. pigeons' dung, and 2 cwt. sulphate of ammonia, ...	8839.0	5.30	38.20	24.70	1.10
25	4 cwt. dissolved bones, and 12 cwt. animal charcoal, ...	9044.0	3.20	26.30	17.30	3.30
	Average, ...	9243.9	3.77	18.93	14.78	1.13

TABLE IV.—(*First Series.*)

ORDER of PRODUCTIVENESS of the TURNIPS in MR FINNIE'S Series.

The comparative productiveness of the different turnips was determined by Mr Finnie, by weighing the produce of a certain length of the drills in each sample. Mr Finnie thought the weighings were made on too small a scale to permit an absolutely accurate estimate of the produce per acre, but sufficiently so to admit of their being arranged in the order of productiveness contained in this Table.

Number.		Number.	
14	1st	2, 7, 16, 22, 24	6th
3, 6, 12, 18, 21	2d	20	7th
1, 11, 15	3d	8, 10, 19	8th
17	4th	4, 9	9th
13, 23, 25	5th	5	10th

TABLE V.

TABLE V.—(*Second Series.*)

TABULAR VIEW of the QUANTITIES of WATER, NITROGEN, PHOSPHATES, and PHOSPHORIC ACID in TURNIPS grown in different Localities, and manured with FARMYARD MANURE and GUANO.

		Water.	Nitrogen.		Phosphates.	Phosphoric Acid.
			In Fibre.	In Juice.		
	WHITE GLOBE TURNIPS, from Mr WAUGH, Eweford, East Lothian—					
1	Dung, ...	9141.0	3.9	17.5	16.8	0.9
2	Dung and Guano	9220.0	3.0	15.6	14.5	1.7
3	Guano, ...	9285.0	2.1	18.0	15.4	0.9
	PURPLE-TOP YELLOWS, *by the same*—					
4	Dung, ...	9120.0	4.0	13.6	10.3	traces
5	Dung and Guano, ...	8972.0	2.9	22.9	17.7	traces
6	Guano, ...	9250.0	2.7	14.0	8.1	0.2
	WHITE GLOBE TURNIPS, from the Cairnies, Perthshire—					
7	Dung, ...	9143.3	2.9	7.6	12.4	0.06
8	Guano, ...	9140.2	3.7	19.9	13.3	0.12
	WHITE GLOBE TURNIPS, from Mr DICKSON, Saughton Mains—					
9	Dung, ...	9037.0	3.2	20.4	17.0	0.3
10	Dung and Guano, ...	9072.0	3.2	17.1	14.0	0.1
	SWEDES, from Mr GIBSON, Woolmet—					
11	20 loads Dung, and 3 cwt. Guano,	9243.0	3.9	11.3	13.2	traces
12	6 cwt. Guano, ...	9383.0	3.8	4.3	12.6	traces
	SWEDES, from Mr M'LEAN, Braidwood—					
13	40 yards Dung, ...	9054.8	1.5	27.8	...	...
14	20 yards Dung, and 3 cwt. Guano,	8952.0	36.8		19.6	0.7
	GREEN-TOP GLOBES, from Mr M'LEAN—					
15	40 yards Dung, ...	9219.7	1.4	25.2	...	...
	SWEDES, from Lord KINNAIRD—					
16	Stored October 1850, ...	9253.8	4.2	9.1	10.5	0.1
17	Pulled February 1851, ...	9300.0	2.1	6.2	6.0	0.1

TABLE VI.—(*Third Series.*)

TABULAR VIEW of the QUANTITIES of WATER, NITROGEN, PHOSPHATES, and PHOSPHORIC ACID in SWEDES and ABERDEEN YELLOW TURNIPS, grown on different Soils on the Property of the Right Honourable Lord KINNAIRD, in Perthshire.

		Water.	Nitrogen.		Phosphates.	Phosphoric Acid.
			In Fibre.	In Juice.		
	SWEDES, CROP 1849.					
1	Clay land, ...	9058.0	2.9	12.9	16.3	0.5
2	Black land, ...	8978.0	4.0	14.2	17.6	0.5
3	Hill land, ...	8712.0	1.7	26.8	15.9	0.6
	SWEDES, CROP 1850.					
4	Clay land, ...	9273.0	3.7	8.6	9.6	traces.
5	Black land, ...	9278.0	4.0	5.9	9.0	traces.
6	Hill land, ...	9 268.0	4.5	10.2	9.8	0.4
	ABERDEEN YELLOWS, CROP 1849.					
7	Clay land, ...	9119.5	3.6	15,9	16.2	1.1
8	Black land, ...	9047.8	3.8	13.7	16.7	0.2
9	Hill land, ...	9057.8	3.9	24.4	13.3	2.8
	ABERDEEN YELLOWS, CROP 1850.					
10	Clay land, ...	9426.3	3.1	7.8	6.8	0.8
11	Black land, ...	9059.0	2.9	13.8	12.17	0.06
12	Hill land, ...	9399.0	3.4	12.0	12.0	1.4

Concluding Observations.

A comparison of the foregoing analyses suggests many points of much interest and importance, some of which have considerable bearings upon the practical opinions of the value of different sorts of turnips for feeding purposes.

In the first place, it is to be observed that the difference in feeding value is much greater than we should, *a priori*, have been led to expect. This difference is most conspicuously seen in the tabular views appended to the analyses, in which are presented at one view the amounts in 10,000 parts of those constituents upon which the comparative feeding values are principally dependent. Selecting the *First Series* of analyses, all of the same variety of turnips, but grown with different manures, we find the proportion of nitrogen in the juice to vary from 10.5 up to as high as 38.2 parts in 10,000, or little short of four times as much in the latter case as in the former. This, however, is an extreme case, as the great majority approximate much more closely to the average. Similar differences are also found in the proportions of phosphates, though not to so great an extent, the highest proportion being 24.7, the lowest 9.2. The variations in the quantity of water, and consequently of solid matters, are also remarkably great. No. 24 contains only 88.39 of water, and 11.61 of solids; and No. 17 has 94.94 of water, and 5.06 of solids, or less than half the amount. As may be expected, the turnips containing the smallest quantity of water are the most valuable, and the proportion of it might even form an approximation indicative of their value. It would, however, be only an approximation, and that a distant one, as may be exemplified by comparison of Nos. 6 and 9, of which the former, with 727 parts of solids in 10,000, contains 19.7 of nitrogen, and the latter 531 of solids and 20.8 of nitrogen, or more nitrogen and less solid matter.

It has been occasionally alleged by cattle-feeders, that guano-grown turnips are inferior to those grown with farmyard manure and other substances; but the analyses, as a whole, by no means confirm this view, but seem to indicate that no such differences exist. In the *First Series*, however, the inferiority of the guano turnips is very marked; but it is not found in those from different localities grown with dung and guano, expressly for the sake of determining this point; where, on the contrary, there is in some instances a very decided superiority of the guano turnips. Nor does it appear in those of Mr Finnie's series, in which guano is associated with other manures. Thus in No. 6, where 6 cwt. dissolved bones were employed, we have 19.7 of nitrogen; but in No. 12, where 3 cwt. dissolved bones and 3 cwt. guano are applied together, the turnips contain 23.6 of nitrogen, and are consequently of superior value.

The turnips of highest value are those grown with pigeons'-dung and sulphate of ammonia; and this is so far remarkable that it is directly at variance with the common statements that manures rich in phosphates are most beneficial to the turnip. Pigeons'-dung is rather poor in these constituents, and it must be considered rather as a nitrogenous than as a phosphatic manure. It appears, indeed, throughout the whole series, that the most valuable turnips have been produced by the nitrogenous manures, and especially by those which do not contain their nitrogen in the state of ammonia, but in such conditions as permit its gradual and slow diminution. Rape-dust and horn-dust are such manures; and they, and the mixtures of which they have formed a part, have generally produced the best turnips. No. 14, Table IV., which is grown with guano and rape-dust, has produced the largest quantity of turnips of above the average value; and, if we may be permitted to draw general conclusions from this, we should infer that the largest amount of the most valuable turnips should be obtained by mixing guano or some of the rapidly acting nitrogenous manures with some of the more slowly acting ones, such as rape-dust. I may also raise the question as to whether the system of growing turnips altogether with the rapidly acting manures, which is now so commonly adopted, is the most advantageous plan, and whether it might not be better, in all cases, to employ these substances only as *part* of the manure of the crop. I think it right, however, to guard against the supposition that the nitrogenous manures are always those most suited for the turnip. There are districts in which they have comparatively little effect—much less, at least, than those containing abundance of phosphates; but in the district about Edinburgh, I believe, the preference is almost universally given to the nitrogenous manures. It would be of great interest and importance to ascertain the circumstances of soil, climate, and weather, under which these different manures produce their effects in the most marked manner; for there is no doubt that they do not invariably prove equally beneficial even in the same locality; but we have not a sufficient amount of accurate experiments to enable us, at present, to arrive at satisfactory conclusions—nor shall we have, until extensive series of experiments are made, in a precisely similar manner, in different parts of the country, throughout a succession of years.

The turnips of the *Second Series* were grown with farmyard manure and guano, and their analyses were made for the purpose of ascertaining the effect of these manures, as well as that of difference of locality, upon their chemical composition. Their results do not by any means point to any particular effect invariably produced. In some instances guano appears to produce a turnip of superior quality to farmyard manure; in some instances it is exactly the reverse, and in others the difference is very

trifling. These differences are most prominent in the amounts of nitrogen, which vary within wide limits, and generally are somewhat larger in those grown with guano. The proportion of phosphates is also somewhat less in those grown with guano; and this result is at variance with the only comparative analysis of such turnips which we hitherto possess, and which was published by Professor Johnston in the *Transactions of the Highland and Agricultural Society*. He found a very decided increase in the proportion of phosphates, but remarks that satisfactory conclusions cannot be drawn from a single experiment.

As far as difference of locality is concerned, inspection of the Table seems to show that no satisfactory connection can be made out between the value of the turnip and the position in which it has been grown. Some of the turnips, as those of Mr Waugh, have been grown nearly at the level of the sea; others, like Mr Finnie's and Mr M'Lean's, at a very considerable elevation, and in a greatly inferior climate, without the quality being manifestly affected; indeed, Mr M'Lean's, which are from a very high and exposed situation, are among the best turnips which have been analysed.

At the end of the *Second Series* are comparative analyses of the same variety of swedes, of which the first had been stored in October 1850, the other pulled in February 1851, at which time both were analysed. The rest indicates a diminution in the feeding value of the turnip, which had been allowed to remain in the ground during the winter, the amount of nitrogen having fallen from 9.1 to 6.2, and that of phosphates from 10.5 to 6.0. This analysis, however, is not sufficient to set at rest the question at issue, and it would be requisite to repeat the analyses upon successive crops, in order to ascertain whether this difference is invariable.

The *Third Series* of analyses I consider to have given the most remarkable and interesting results of all. They refer to the comparative values of turnips grown upon three different soils in Perthshire, and were undertaken for the purpose of determining how far the popular opinion prevalent in that district as to the inferiority of turnips grown on clay land, is correct. Of the soils examined, the first clay soil is the heavy alluvial clay of the Carse of Gowrie, which is a wheat soil of the best description, and well known for the abundance and excellence of its wheat crops. The third, or hill land, is a light loamy soil, which prevails in the rising ground, and which, though a good soil, is of an entirely different character from the Carse clay, and incapable of producing the same grain crops, and lets at a much inferior rent. The second, or black land, forms the boundary between the two former, and partakes of the characters of both, those of the clay, however, preponderating. The turnips all received the same quantity of manure, and their treatment was in all respects exactly the same. The analyses of the turnips of crop 1849, both swedes and yellows,

give the most unequivocal evidence of the superiority of the turnips from the hill land; so great, indeed, is the difference that the proportion of nitrogen, and consequently of protein compounds, on which the flesh-forming power of the turnips is principally dependent, is little short of twice as much in the hill-land turnips as it is in those grown on clay land. These results appeared so remarkable that I was induced to repeat the analyses upon turnips grown on the same soils in the year 1850; and it will be seen that a similar result was obtained, although the differences are much less marked, and, are indeed, quite trifling when compared with those of the previous year. Still, however, they are sufficiently distinct, and unequivocally confirm the results obtained from the crop of the preceding season. In this instance, then, the results of practical experience are fully borne out by scientific experiment; and they are, I think, no other than we should have been led to form from the general characters of the soils. It is well known that the turnip does not flourish in heavy soils, and that it is most luxuriant in those light loams which are distinguished as *turnip soils*. The hill land, though not a true turnip soil, approximates to it in its general characters, and produces a superior turnip to that produced on the heavy soil, which for other crops is unequivocally superior and more valuable. These analyses further indicate the very unequivocal difference in value of the same turnips grown under exactly similar circumstances in different seasons. All the turnips of crop 1850 are greatly inferior to the corresponding ones of 1849. In those of 1849 we have the quantity of solids amounting, on the average of all the turnips, to about 10 per cent, but in those of 1850 it is not more than 7, and a corresponding inferiority is found also in the nitrogen and phosphates. It is not easy to trace the cause of this difference, but much might be done by a series of experiments extending over a series of years.

The analyses of the *Fourth Series* of turnips do not call for much observation. They form an interesting series of experiments in the cultivation of the turnip, with different varieties of manufactured manures. The low value of some of these is indicated by the fact, that two of them at least, Nos. 4 and 5, do not pay the cost of the application; indeed, the same may be said of Nos. 8 and 9, which were manured at a larger cost than the others. Some of these, however, yield a considerable profit, and that, coupled, in some cases, as in No. 6, with an improvement in the quality of the turnip, as indicated by the increased proportion of nitrogen and diminished quantity of water. In the case of Nos. 1 and 2, in which the greatest gain or weight is found, it has been obtained at the cost of a diminution in the quality of the turnip, though by no means sufficiently great to counterbalance the increased weight.

From a careful consideration of all the analyses, I think the following conclusions may be drawn :—

1*st*, Turnips grown with different manures differ very greatly in quality.

2*d*, Turnips grown with guano cannot, on the whole, be considered inferior to those grown with other manures; on the contrary, though in some cases below, they are in others decidedly above the average.

3*d*, In the turnips grown for experiment, the most valuable are those produced by the mixture of a rapidly and a slowly acting nitrogenous manure.

4*th*, That the locality and weight at which turnips are grown does not appear to exert any influence on the crop.

5*th*, That the value of turnips is materially affected by the nature of the soil in which they are grown; that those of highest value are produced by light loamy soils, and that heavy clay lands produce a decidedly inferior turnip.

I had purposed to include in the present paper a discussion of the important subject of finger-and-toe, which I was the more anxious to do as the disease appeared to some extent in the turnips of Mr Finnie's series. As, however, the whole subject of the turnip disease has been referred by the Highland and Agricultural Society to Professor Balfour and myself for a joint botanical and chemical report, I shall reserve all that I should have to say now, till such time as we are in a condition to report to the Society the results of the investigations now in progress, which are rapidly approaching completion.

ON SOME SUBSTANCES WHICH MAY BE EMPLOYED IN AGRICULTURE AS SUBSTITUTES FOR LIME.

Limestones are generally so abundant throughout Scotland, and lime, consequently, so cheap, that comparatively little attention has been paid to marls and other substances which may be employed in its place. I have had occasion to examine a few marls, and it has occurred to me that the publication of the analyses might be of some service in directing attention to the subject; and I shall take the same opportunity of referring to some other sources of lime and its compounds, which may be advantageously employed for agricultural purposes.

Marls.—The following are analyses of marls, the one from Applecross, the other from Assynt in Sutherlandshire :—

	Applecross.	Assynt.
Silica,	0.87	1.51
Alumina and peroxide of iron,	0.32	1.46
Carbonate of lime,	96.13	82.21
Carbonate of magnesia,	1.75	12.69
Alkaline salts,	...	0.86
Organic matter,	...	0.40
Water,	0.37	1.16
	99.44	100.29

In both the localities in which these marls are found, lime is a very expensive article—not so much owing to the absence of limestones, for these, at least in Sutherlandshire, are sufficiently abundant, but owing to the want of fuel for burning. So great, indeed, is the expense of lime, and so much is it required for the agricultural improvements, that mills have been erected for the purpose of crushing limestone into a coarse powder, which has been extensively employed, and I believe with good effect. The Applecross marl is of remarkably fine quality, and is, indeed, nearly pure carbonate of line; it is also in a very fine state of division, and its discovery is a great boon to the district. That from Assynt is somewhat inferior, but is still valuable; the only disadvantages it presents being that it contains a quantity of carbonate of magnesia. A marl from the same district has also been analysed by Professor Johnston, which, however, contained only 49.92 per cent of carbonate of lime, and 36.23 per cent of carbonate of magnesia—a quantity so large as greatly to diminish the value of the marl, and to render caution necessary in its application in large quantities. It is not improbable that marls might be found more abundantly in these districts, if they were carefully examined by competent persons; but Professor Johnston's analysis shows that they cannot always be safely made use of. Everything depends, of course, upon the value of the limestone, by the disintegration of which the marl is produced; and a pretty extensive series of analyses of limestones from Sutherlandshire which have been made in the laboratory, and which I shall probably make public at some future opportunity, have shown that many of these are extremely rich in magnesia.

A marl of a different source was sent to the laboratory for analysis by Mr Young, Collinswell, Fifeshire. It was found on draining Kinghorn Loch. The bottom in one part was found covered with a thick deposit of a white marl, and over the whole of the rest a fine black matter was found. Both of these substances were analysed.

	Marl.	Black Matter.
Silica,	0.316	82.296
Alumina and paroxide of iron,	2.027	8.654
Carbonate of lime	94.594	1.326
Carbonate of magnesia,	1.634	2.996
Magnesia,	0.865	0.384
Organic matter,	0.360	4.344
	99.796	100.000

The first of these is therefore a marl of excellent quality; the second, which Mr Young proposed to apply as a top-dressing, I reported to have little value, and that any effects it produced would be attributable more to its high state of mechanical division than to its chemical composition. The true marl was deposited in a very small space, near the point at which a small stream entered

the loch, from which it was probably deposited; and it is interesting to observe how completely that had been done before the water had reached any distance into the loch, the black matter containing only a trifling quantity of lime and magnesia.

Roasted shale of the coal formation.—A sort of shale which is met with in the neighbourhood of Falkirk, and which is roasted at the mouth of the coal-pits there, was some time since analysed in the laboratory, and is worth notice as a source of lime, and, from its other constituents, as probably a valuable application to heavy clay lands. Its composition was as follows:—

Water,	2.327
Carbonaceous matter,	1.055
Peroxide of iron and alumina,	8.346
Lime,	10.789
Carbonate of lime,	20.894
Sulphate of lime,	2.101
Magnesia,	0.209
Alkaline sulphates,	2.343
Chlorine,	traces
Ammonia,	traces
Silica,	51.978
	100.042
Total quantity of lime,	23.143

The quantity of lime which this substance contains is sufficiently large to make it worthy of attention, the more especially as a certain part of that which it contains exists in the state of gypsum, and a quantity of alkaline salts is also present. As this substance is not only a refuse, but a source of annoyance in the neighbourhood of coal-pits, the proprietors are generally glad to give permission for its removal without charge.

Lime refuse of the prussiate works.—In a former paper I communicated the analysis of a couple of specimens of the refuse frequently sold under the name of animal charcoal by the prussiate manufacturers. The following is that of another refuse obtained in the conversion of sulphate into carbonate of potash, which is rich in lime, and contains also a considerable quantity of potash:—

Sand,	5.88
Lime,	46.35
Magnesia,	0.52
Oxide of iron,	2.24
Potash,	1.69
Soda,	0.01
Sulphur,	8 97
Sulphuric acid,	2.15
Carbonic acid,	12.76
Water,	19.43
	100.00

This substance would also be useful as a source of lime, but it ought to be obtained at a very low price; indeed, if it is to be

carried any distance, the farmer could scarcely afford to pay for it at all. He would require, when calculating the cost of carriage, to bear in mind that it is equivalent to half its weight of quick-lime, and to estimate the cost of it accordingly.

Lime-refuse of the bleach-works.—This is the refuse-lime which has been employed by the bleacher for converting carbonate of soda into caustic soda. It was sent to the laboratory for analysis by a gentleman, who stated that he could obtain it at the bleach-works free of charge. Its composition was as follows:—

Carbonate of lime,	44.02
Slaked lime,	13.53
Carbonate of soda,	2.44
Sand,	0.32
Water,	39.80
	100.11
Total quantity of lime,	34.89

From this analysis it will be seen that this refuse is much in the same predicament as the last; if it can be obtained for nothing, and without much cartage, it may be usefully employed, but not unless.

Many other manufacturing operations yield refuse-matters containing abundance of lime. Soap manufactories, soda-works, and the like, are in this condition; but as these establishments are very frequently set down in localities where lime is naturally abundant and cheap, their refuse is far less important than if they happen to be placed where lime is scarce. It would be well if persons interested in agriculture would direct attention to such substances wherever they are to be found, as they may often prove important auxiliaries to improvement.

ANALYSIS OF A SOIL SPECIALLY ADAPTED TO THE CULTIVATION OF THE SUGAR-CANE.

Some considerable time since I published in the *Transactions of the Highland and Agricultural Society* a series of very elaborate analyses of the most prolific wheat soils of Scotland. It may be of some interest to contrast these analyses with that of a sugar-cane soil, which has been carefully analysed in my laboratory by Mr Thomas Kerr. The soil is from the Cocoa-nut Hall estate in Antigua, and the samples were taken from the field immediately after being three years under sugar-cane, which had yielded a very great return. The surface-soil was most minutely analysed, the constituents of the watery solution being determined, as well as the humine and humic acid. In the subsoils the aqueous constituents were not determined, and in their analysis they are consequently included in the portion soluble in acids. The humine and humic acid are also included in the organic matter.

	Surface-soil.		Subsoil 18 inches down.		Subsoil 3 feet down.		Subsoil 5 feet down.	
Soluble in Water—								
Lime, ...	0.07							
Magnesia, . . .	trace							
Potash, ...	0.06							
Soda, ...	0.04							
Chlorine, ...	0.05							
Organic matter, .	0.15							
		0.37						
Soluble in Acids—								
Silica, ...	0.74		...		1.26		...	
Peroxide of iron, .	2.22		1.67		10.18		1.87	
Protoxide of iron, .	0.77		9.05				3.10	
Alumina, ...	1.90		2.52		4.41		4.21	
Lime, ...	10.43		3.04		9.17		25.75	
Magnesia, . . .	0.20		0.54		0.57		0 51	
Potash, ...	0.03		0.29		0.26		0.28	
Soda, ...	0.02		0.11		0.17		0.16	
Sulphuric acid, . .	trace		0.02		0.01		0.13	
Phosphoric acid, .	0 14		trace		0.09		0.04	
Carbonic acid, . .	7.38		9.82				20.23	
Humine, ...	1 58				1.39			
Humic acid, . .	1.15		12.05		0.92		7.49.	
Organic matter, . .	7.66				8.52			
		34.22		30.11		52.39		63.77
Insoluble in Acids—								
Silica, ...	41.44		51.24		40.95		27.67	
Protoxide of iron, .	3.24		0.26		...		1.40	
Alumina, . . .	9.00		1.50		2.78		1.00	
Lime, ...	0.08		0 88		0 61		trace	
Magnesia, . . .	0.80		0.54		1.29		trace	
Potash, ...	. .		0.74		1.91		...	
Soda, ...	. .		0.25					
		54.56		55.41		47.54		30.07
Water, ...		11.13		14.69		15.44		6.06
		100.28		100.21		99.93		99.90

This soil forms a very interesting contrast to the wheat soils to which I have referred. It is remarkable for its extreme depth; the subsoil, five feet below the surface, still bearing a general resemblance to the soil itself. The great abundance of lime also distinguishes it from those which we commonly meet with in this country; nor is protoxide of iron generally so abundant. The most interesting point regarding it is the great diminution of the amount of alkalis in the surface-soil, which is consistent with our knowledge of the composition of the sugar-cane, than which few plants require a larger quantity of alkalis. How far the presence of lime in large quantities may be beneficial, or whether it is commonly found in the soils of the West Indies, I am unable to say. It would appear, however, that limestone is a very abundant formation in the island of Antigua. Mr Kerr analysed a specimen of a coral limestone from that island, the results of which I append, as it is interesting from its containing an appreciable quantity of phosphate of lime and of alkaline chloride.

Silica, ...	3.90
Carbonate of lime, ...	91.70
Carbonate of magnesia, ...	2.31
Peroxide of iron and alumina, ...	1.19
Phosphate of lime, ...	0.39
Chloride of sodium, ...	0.19
Chloride of potassium, ...	0.15
	99.83

FEEDING PROPERTIES OF TURNIPS GROWN WITH DIFFERENT MANURES.

By MR WILLIAM GOODLET, Factor to Lord Blantyre, Erskine, Renfrewshire.

[Premium—The Gold Medal.]

A PORTION of a field of 20 acres, on the farm of Beauchamp in Forfarshire, intended for turnips last year, (1850,) was selected for its equal quality of soil and exposure, upon which to grow the lots to be experimented with. The soil is a good friable loam, and the field, which had been manured for a bean crop in 1848, was in wheat in 1849, and ploughed in the autumn with a good furrow for turnips in the following season.

Plot No. 1 got 20 tons of well-made farm-yard dung per acre.
„ No. 2 got 4 cwt. of Peruvian guano per acre.
„ No. 3 got 10 tons of like dung, and 2 cwt. of like guano per acre.

The turnip seeds—Skirving's purple-top yellow—were sown on 26th May. They brairded pretty much alike; those with guano continued throughout the season to show rather most luxuriance of growth, but on the crops arriving at maturity little or no difference was discernible between them.

From the commencement of the experiment on 21st October to its close on the 10th March, the cattle in—

Lot	No.	I.	Consumed	3	acres	2	roods	27	poles,	weighing	96	tons	14	cwt.	1	qr.
„	No.	II.	„	3	„	2	„	4	„	„	96	„	13	„	1	„
„	No.	III.	„	3	„	2	„	11	„	„	96	„	10	„	0	„

The turnips were brought from the field as required, about an eight days' supply usually being in store; and from first to last they were taken clean and in good order from the field, the tops and roots being left behind. They were given to the cattle by weight and measure.

The cattle experimented on were a lot of two-year-old shorthorn crosses, reared by Sir George Dunbar in Caithness-shire, brought from their grazings a considerable distance, and after being allowed a little time to recover from the fatigue of their journey, were on the 21st October carefully divided into three lots of seven each by competent judges, weighed and put into their respective feeding courts, which are exactly of the same form and construction, having each ample shed-room in a building on their north side, and being surrounded by high walls on the other three sides, with feeding-troughs in the *open court* for turnips, racks within the sheds for straw, and a southern exposure. Lot I. was put on the turnips grown with dung alone, Lot II. on the turnips grown with guano alone, and Lot III. on turnips with half dung, half guano.

The weather was fine and dry when the cattle were put up,

and continued so till towards the end of December, about the beginning of which were a few days of dull hazy weather, inclining to frost; and during its continuance all the Lots eat about 35 lb. less turnip each beast per day than usual; about the 30th December much rain fell, and till 13th January it continued very wet. The cattle were observed to scour a good deal, and they eat very little straw; indeed, from the beginning the consumpt of straw was very small. It was then deemed advisable to give them hay. The average consumpt of turnips till this time was 227 lb. each beast per day, but after being put on hay, of which they were allowed as much as they eat up clean, (11 lb. each beast daily,) the average consumpt of turnips decreased to 216 lb. each beast per day. At the end of the fourth month, (that being the shortest period allowed by the terms of competition for the experiment with turnips alone,) it was resolved to give them a small allowance of oilcake, in order to see the effect it might have on hastening forward their fattening. Accordingly, 2 lb. of oilcake were allowed to each beast daily, along with their hay and turnips; after which the consumpt of turnips fell to 209 lb., and of hay to 10 lb., each beast per day, and it continued at that rate till the close of the experiment.

During the wet weather in the beginning of January, three of the cattle—one of each Lot—(No. 2 of Lot I., and No. 4 of Lot II., and No 2. of Lot III.,) were not doing so well, and were bled, and got each a doze of salts. They soon after recovered, and made up to the others, the bleeding and medicine having had no permanently bad effects in retarding their feeding, but, on the contrary, seemed to give an impetus to it after they recovered from the immediate effects of their medical treatment.

All the cattle of each Lot were weighed once every four weeks, and four of each lot were weighed once every fortnight. The weighings invariably took place between the hours of 3 and 4 o'clock afternoon. It was feared the frequent weighings might disturb the animals, and probably have an adverse influence on their fattening; and it was thought that weighing the *same four* fortnightly would be sufficient to test the progressive improvement, and that the bad effects, if any, from the weighings would be seen by contrast with the other three of each lot which were weighed only once a month. It may be mentioned, however, that the cattle generally were very tractable, and by the end of the experiment the weighing seemed to give them no uneasiness, the cattle-man leading them on by their horns to the weighing machine with the greatest ease and composure possible.

The following Tables show the progressive improvement in weight during the course of the experiment:—

Table I.,

Showing the Increase in Weight in lb. at the end of every 4 Weeks, from the commencement of the Experiment on 21st October to its close on 10th March.

LOT I.—FED ON TURNIPS GROWN WITH DUNG ALONE.

	18th Nov.	16th Dec.	13th Jan.	10th Feb.	10th March.	Total increase.
	lb.	lb.	lb.	lb.	lb.	lb.
No. 1.	66	112	96	104	136	514
„ 2.	60	85	90	18	107	360
„ 3.	64	65	118	30	123	400
„ 4.	56	104	92	44	78	374
„ 5.	52	61	74	14	60	261
„ 6.	59	66	38	66	67	296
„ 7.	46	51	85	90	61	333
	403	544	593	366	632	2538

LOT II.—FED ON TURNIPS GROWN WITH GUANO ALONE.

	18th Nov.	16th Dec.	13th Jan.	10th Feb.	10th March.	Total increase.
	lb.	lb.	lb.	lb.	lb.	lb.
No. 1.	58	54	89	61	84	346
„ 2.	71	92	96	59	86	404
„ 3.	76	50	77	33	28	264
„ 4.	43	41	34	78	111	307
„ 5.	80	67	83	48	58	336
„ 6.	50	57	91	30	111	339
„ 7.	54	57	79	60	72	322
	432	418	549	369	550	2318

LOT III.—FED ON TURNIPS GROWN WITH HALF DUNG, HALF GUANO.

	18th Nov.	16th Dec.	13th Jan.	10th Feb.	10th March.	Total increase.
	lb.	lb.	lb.	lb.	lb.	lb.
No. 1.	33	88	99	113	134	467
„ 2.	54	85	73	69	98	379
„ 3.	31	59	65	46	76	277
„ 4.	54	74	105	87	78	398
„ 5.	45	82	60	55	42	284
„ 6.	29	52	56	43	108	288
„ 7.	25	48	64	66	139	342
	271	488	522	479	675	2435

Table II.,

Showing the Increase in Weight, every fortnight, of Four of the Cattle of each Lot, from 21st October to 10th March.

Cattle of Lot I., weighed and put up on 21st October, and weighed again on—

	Nov. 4.	Nov. 18.	Dec. 2.	Dec. 16.	Dec. 30.	Jan. 13.	Jan. 27.	Feb. 10.	Feb. 24.	Mar. 10.	Total.
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
No. 1.	26	40	46	66	30	66	54	50	44	92	514
„ 2.	24	36	54	31	39	51	lost 5	23	41	66	360
„ 4.	28	28	38	66	36	56	29	15	25	53	374
„ 6.	41	18	28	38	18	20	26	40	18	49	296
	119	122	166	201	123	193	104	128	128	260	1544

Cattle of Lot II., weighed and put up on 21st October, and weighed again on—

	Nov. 4.	Nov. 18.	Dec. 2.	Dec. 16.	Dec. 30.	Jan. 13.	Jan. 27.	Feb. 10.	Feb. 24.	Mar. 10.	Total.
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
No. 1.	24	34	26	28	48	41	44	17	24	60	346
„ 2.	23	48	33	59	38	58	28	31	13	73	404
„ 4.	28	15	14	27	32	2	23	55	28	83	307
„ 6.	21	29	27	30	46	45	7	23	46	65	339
	96	126	100	144	164	146	102	126	111	281	1396

Cattle of Lot III., weighed and put up on 21st October, and weighed again on—

	Nov. 4.	Nov. 18.	Dec. 2.	Dec. 16.	Dec. 30.	Jan. 13.	Jan. 27.	Feb. 10.	Feb. 24.	Mar. 10.	Total.
	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.	lb.
No. 1.	17	16	29	59	47	52	55	58	46	88	467
„ 2.	19	35	18	67	35	38	38	31	47	51	379
„ 4.	22	32	28	46	56	49	45	42	29	49	398
„ 6.	20	9	27	25	31	25	5	38	36	72	288
	78	92	102	197	169	164	143	169	158	260	1532

According to Table I., Lot I., fed on turnips grown with dung alone, produced an increase in the live-weight of . . . . 2538 lb.
And Lot II., fed on turnips grown with guano alone, produced an increase of 2318 „

Making a difference in favour of the former of . . . . . 220 lb.

Assuming 6-10ths as equal to the dead-weight, we have 132 lb., estimated at 5d. per lb., equal to 55s., as the increase in money-value on the lot, or an average of 7s. 10¼d. for each beast; and there being 3 acres 2 roods 27 poles of turnips consumed by this Lot, the advantage in favour of the dung-grown turnips is equal to about 15s. 7d. an acre.

The Lot fed on the turnips grown with half dung and half guano hold an intermediate position between the other two Lots, and fairly leads to the inference, which they support, that dung-grown turnips *have* an advantage in feeding qualities over those grown with guano, although that advantage, as shown by this experiment, is not so great as to compensate for the greater cost of dung, and the ready facilities afforded by guano for growing a much larger extent of turnips on the farm than could be done if farmyard manure alone were used. Assuming the other expenses of the turnip crop grown with different manures to be equal, the cost for dung in this experiment is, at 5s. per ton, £5 per acre; for guano, £2 per acre; and for half dung half guano, £3, 10s.: so that, unless the subsequent crops make up for this difference of cost, a loss of £3 per acre, minus the 15s. 7d. per acre gained in feeding, as shown above, will give the results of growing turnips with dung instead of guano, for feeding cattle. It might have been desirable to have had the dead-weight of the animals, and also a test, by chemical analysis or otherwise, of the comparative qualities of the beef for the table; but they were sold to a dealer for a distant market, and these could not be obtained.

Independently of the more direct results brought out by this experiment, there are two collateral points illustrated by the Tables worthy of remark. The first is in reference to the effect which the state of the weather has on feeding cattle in open courts. It will be seen that, after the continued wet weather in the beginning of January, a very serious check took place in the progressive increase of weight among all the Lots—some of the cattle making little or no progress for nearly a month, and the general increase falling, in Lot I., from 593 to 366, and in Lot II., from 549 to 369. In Lot III. the deficiency is not so marked, but still sufficient to show that, in open-court feeding, there is this disadvantage attending it in wet unsuitable weather, even although the cattle have ample cover under sheds, if they choose to avail themselves of it. The other fact strikingly established by the Tables is the great benefit derived from giving cattle even a small allowance of oilcake along with their turnips. Although, during the last four weeks, only 2 lb. per day were given to each beast, the increased weight gained by all the Lots exceeded that of any of the four previous months—especially that of Lot III., which does not appear to have suffered so severe a check from the weather in the previous month as the other

two Lots—the highest increase of *that* Lot, before getting the oilcake, being 522 lb. per month; while, during the month it was given, the increase was 675 lb.

The following Table exhibits the weight of the cattle at the commencement and close of the experiment, and their increase in weight during it:—

	Weight on 21st Oct.			Weight on 10th Mar.			Increase during the experiment.		
Lot I.									
	cwt.	qrs.	lb.	cwt.	qrs.	lb.	cwt.	qrs.	lb.
No. 1.	12	3	0	17	1	10	4	2	10
„ 2.	10	1	14	13	2	10	3	0	24
„ 3.	9	2	21	13	1	1	3	2	8
„ 4.	10	0	0	13	1	10	3	1	10
„ 5.	10	2	24	13	0	5	2	1	9
„ 6.	10	3	25	13	2	13	2	2	16
„ 7.	10	3	13	13	3	10	2	3	25
	75	1	13	98	0	3	22	2	18
Lot II.									
	cwt.	qrs.	lb.	cwt.	qrs.	lb.	cwt.	qrs.	lb.
No. 1.	12	3	0	15	3	10	3	0	10
„ 2.	12	0	5	15	2	17	3	2	12
„ 3.	9	3	0	12	0	12	2	1	12
„ 4.	10	1	0	12	3	27	2	2	27
„ 5.	10	3	22	13	3	22	3	0	0
„ 6.	10	3	7	13	3	10	3	0	3
„ 7.	10	2	0	13	1	14	2	3	14
	77	0	6	97	3	0	20	2	22
Lot III.									
	cwt.	qrs.	lb.	cwt.	qrs.	lb.	cwt.	qrs.	lb.
No. 1.	11	0	23	15	1	14	4	0	19
„ 2.	11	0	12	14	1	27	3	1	15
„ 3.	10	1	23	12	3	20	2	1	25
„ 4.	10	1	22	14	0	0	3	2	6
„ 5.	10	1	11	12	3	15	2	2	4
„ 6.	11	1	0	13	3	8	2	2	8
„ 7.	12	1	3	15	1	9	3	0	6
	77	0	10	98	3	9	21	2	27

The cattle were bought, in October 1850, at £12, 5s. a-head, and valued, when put up to feed, at £12, 17s. 6d. a-head. They were sold, with the exception of two, (No. 3 in Lot II., and No. 3 in Lot III.,) on 10th March, for £16, 10s. a-head. The two reserved were at that time estimated to be worth £15 a-head. The cattle were sold in slump; but it was considered, both by buyer and seller, that Lot I. was worth from 6s. to 8s. a-head more than the other Lots—which opinion coincides with the results furnished by the weights already given.

On the WEIGHT of TURNIPS of CROP 1851 on VARIOUS FARMS in the MIDDLE and UPPER DISTRICTS of ANNANDALE.

The following Table, showing the weight of turnips of crop 1851, on the various farms mentioned in it, in the middle and upper districts of Annandale, as also the accompanying Report by the Lockerbie Farmers' Club on the contents of the Table, were kindly communicated to the Society by Charles Stewart, Esq. of Hillside, Dumfriesshire, to whom Annandale owes much, as the originator of a system which has worked well, and given satisfaction to its Farmers.

The respective fields were inspected between the 17th and 25th of November 1851.

AMES OF FARMS, PARISHES, AND OF KINDS OF TURNIPS.	Width of Drill in Inches.	No. of Turnips on 10 Yards.	Weight. Per Scotch Acre.		Weight. Per Imp Acre.		Manures. Farmyard Dung.	Peruvian Guano.	Dissolved Bones.	Ground Bones.	Bone Meal.	S. Phos. of Lime.	Date of Sowing.
			tons	cwt	tons	cwt	cubic yards	cwt	cwt	bus	bus	cwt	
ARDGRAVE, *Dalton*													
White Globe	28	28	25	11	20	5	15	2½	1	13			19th June
Dale's Hybrid	27	32	31	12	25	1	15	2½	1	13			19th June
Purple Top Yellow	27½	29	24	12	19	10	15	2½	1	13			17th June
Do. Swedes	26½	25	31	2	24	13	15	2½	1	13			24 to 28th May
Do. Do.	28½	26	37	10	29	15	15	2½	1	13			22 to 23d May
ORMONT, *Dalton*													
Swedes	29	35	27	1	21	9		2		17			27 to 30th May
White Globe	29	38	34	10	27	7		2		17			13 and 14 June
Yellow Bullock	29	36	20	19	16	12		2		17			19 to 21st June
REEN-HILLHEAD, *Lochmaben*													
Hardy Green	27½	32	23	7	18	10	18	2		6			16 to 18th June
Yellow Bullock	27½	39	28	10	22	12	18	2		6			30 May to 16 do.
Swedes	27½	33	27	2	21	10	24	2		10			22 to 29th May
RESTONHOUSE, *Lochmaben*													
Swedes	29½	[illegible]	29	12	23	9	15	2½		10			
MALLHOLM, *Lochmaben*													
Swedes	27	41	27	16	22	0	18	2		10			26 May to 5 June
Yellow Bullock	26½	47	22	19	18	4	18	2		10			Do. Do.
ALLEATHS, *Lochmaben*													
Swedes	28½	39	30	11	24	4	16	2				1½	20 to 26th May
Do., (Laing's)	27½	37	33	14	26	14	16	2				1½	Do. Do.
ALLFIBBLE, *Kirkmichael*													
Swedes	28½	31	28	18	22	18	12	2¼		12			13 to 17th May
Do.	28½	32	21	7	16	18	10	2		12			6th June
Pomeranian, White	28	33	41	13	33	1	10	1½		12			7th June
Yellow Bullock	28	33	18	18	15	0	12	2					10 to 14th June
ALTONHOOK, *Dryfesdale*													
Swedes	28½	30	30	9	24	3	15½	4¾		18½			30 May to 5 June
Hardy Green	28½	30	27	4	21	11	15½	4¾		18½			7th to 13th June

[*Table Continued.*

Names of Farms, Parishes, and of Kinds of Turnips.	Width of Drill in Inches.	No. of Turnips on 10 Yards.	Weight. Per Scotch Acre.		Weight. Per Imp. Acre.		Manures. Farmyard Dung.	Peruvian Guano.	Dissolved Bones	Ground Bones.	Bone Meal.	S Phos of Lime.	Date of Sowing.
			tons	cwt	tons	cwt	cubic yards	cwt	cwt	bus	bus	cwt	
Hillside, *Dryfesdale*													
Hardy Green (Skirving's) .	28	36	37	2	29	8	27	2	3⅜				12th May
Purple Top Swedes, Do. . .	26¾	32	29	10	23	8	27	2	3⅜				12 and 13 May
Do., Do. . .	26	29	30	11	25	10	27		6⅜				13th May
Green Top Swede	28	30	19	19	15	16	20	2		20			20th May
Purple Top Do.	27	30	28	3	22	6	20	2		20			22d May
Green Top Swede	28	30	20	13	16	8	27	2	3⅜				20th May
Purple Top Do.	28	25	24	10	19	9	27	2	3⅜				19th May
Purple Top Yellow	27½	35	18	11	14	14	20	1	2½				5th June
Green Top Do.	28	29	21	14	17	4	20	1	2½				4 and 5th June
Do. Do.	27	33	17	8	13	16	20	1		20			4th June
Do. Do.	26½	40	23	3	18	7	35						4th June
Kirkburn, *Dryfesdale*													
Swedes	27	34	25	8	20	3	25	3		15			17 to 24th May
Green Top Yellow	27	34	27	1	21	9	18	3		12			4 to 6th June
Purple Top Do.	28	36	26	10	21	0	18	3		12			24 to 31st May
White Globe	27¼	35	34	7	27	4	18	3		12			12th May
Broomhouses, *Dryfesdale*													
Purple Top Swedes	27½	35	25	17	20	10	25	2			0¾		17th May
White Globe	28½	37	35	7	28	1	25	2					17th May
Do.	27½	44	28	4	22	7	24	2					6th June
Purple Top Yellow	27½	39	27	2	21	10	20	2					16th June
Green Top Do.	27½	43	22	13	17	19	24	2					6th June
Dryfesdale Manse, *Dryfesdale*													
Purple Top Swedes	27½	31	26	15	21	4	24	2		8			19th to 24th May
Dryfeholm, *Dryfesdale*													
Purple Top Swedes	29½	35	24	0	19	1	20	2					26th May
Green Top Do.	30	36	17	3	13	12	20	2					26th May
Purple Top Yellow	28	41	19	19	15	16	20	1½					20th June
Torwood, *Dryfesdale*													
Swedes	27¾	40	26	10	21	0	12	2½		12			28th May
Green Top Yellow	27	30	21	8	17	0	10	2		10			15th June
Becton, *Dryfesdale*													
Swedes	28	35	24	14	19	11	25	1½		10			20th May
Green Top Yellow	27	43	27	1	21	9		2½		13			20th May
White Globe	28	43	29	15	23	12		2½		13			15th May
Millbank, *Applegarth*													
Green Top Yellow	28	35	17	5	13	13		2½		12			2d June
Do. Swedes	28	43	19	17	15	15	20	2					16th May
Purple Top Do.	28	43	21	0	16	13	20	2					17th May
Green Top Yellow	28	41	19	5	15	5	15	2					14th June
Lammonbie, *Applegarth*													
Green Top Yellow	27½	43	18	0	14	5	25						1st June
Do. Do.	28½	40	23	8	18	11	20	2½					16th May
Do. Do.	28½	45	18	5	14	9		3		12			10 to 17th June
Purple Top Swedes	28½	37	21	14	17	4	20	2½					16th May
Muirhousefoot, *Applegarth*													
Green Top Yellow	28	45	20	10	16	5		2½		15			15th June
Purple Top Do.	28½	44	22	17	18	3		2½		15			15th June
Purple Top Swedes	29	37	18	13	14	16	15	2½		10			13th June
Fishbec, *Applegarth*													
Purple Top Swedes	29¼	40	26	0	20	13	25	3					21st May
Green Top Yellow	28½	38	22	0	17	9	20	2					6 and 9th June
Broadholm, *Applegarth*													
Swedes	29	54	29	18	23	14	16	2				1½	20 to 24th May
Dinwoodie Mains, *Applegarth*													
Swedes (Skirving's)	28½	35	29	19	23	15	18	4					26th May
Do. (Lothian)	28½	32	25	13	20	6	18	4					15 to 20th May
Yellow Bullock	28½	30	15	16	12	11	7	2					28th June
Dalmacadder, *Applegarth*													
Hardy Green	26	38	29	16	23	12	15	2½					5th June
Purple Top Yellow	26	35	26	0	20	12	15	2½					2d June
Swedes (Skirving's)	27	39	23	19	19	0	17	2½					21 to 27th May
Hangingshaw, *Applegarth*													
Swedes	30	41	21	11	17	3	28	2½					20 to 26th May
White Globe	30	39	18	19	15	0		4					28th June
Purple Top White	30	49	18	19	15	0		4					29th June
Dinwoodie-Green, *Applegarth*													
Swedes (Lothian)	29½	33	23	12	18	14	30	2					17 to 26th May
Balgray, *Applegarth*													
Purple Top Yellow	27	44	21	16	17	5	20	3					15th June
Swedes	24	43	24	18	19	15	30						26th May

Names of Farms, Parishes, and of Kinds of Turnips.	Width of Drill in Inches.	No. of Turnips on 10 Yards	Weight. Per Scotch Acre.	Weight. Per Imp. Acre.	Manures. Farmyard Dung.	Peruvian Guano.	Dissolved Bones.	Ground Bones.	Bone Meal.	S. Phos. of Lime.	Date of Sowing.
			tons cwt	tons cwt	cubic yards	cwt	cwt	bus	bus	cwt	
CLEUGHHEADS, *Applegarth*											
White Globe	29	44	20 6	16 2	25						27 to 30th May
Yellow Bullock	29	44	17 5	13 13	25						2d June
Do.	29	55	14 4	11 5		4					21st June
Purple Top Yellow	29	38	17 5	13 13		4					28th June
SHAW, *Hutton*											
Purple Top Swedes	28	26	24 3	19 3	20	3	4				15 and 16th May
Hardy Green	28	29	25 11	20 5	20	2½					20th May
Purple Top Yellow	28	29	15 15	12 10	20	2½					24th May
Yellow Bullock	28	36	17 19	14 3	20	2½					8 to 10th June
Purple Top White	28	28	21 7	16 18	20	2½					5th June
KIRKHILL, *Wamphray*											
Swedes (Lothian)	27½	30	20 6	16 2	25	2			1		24th May
Do. (Skirving's)	29	32	16 8	13 0	28	2					21st May
Yellow Bullock	27½	32	21 8	16 19	25	2			1		6th June
Hardy Green	27½	37	21 8	16 19		2½		22			10th June
Do.	29	31	27 14	21 18	28	2					21st May
White Globe	27½	36	21 15	17 5	22	2½					12th June
PUMPLIKBURN, *Wamphray*											
Swedes	28	27	15 18	12 12	18	3					16th May
Yellow Bullock	30	43	21 5	16 17	18	3					19th May
Green Top White	30	30	18 19	15 0	18	3					20th May
WAMPHRAYGATE, *Wamphray*											
Green Top White	28	33	12 5	9 14	18	2					27th June
Do. Do.	28	42	15 15	12 10	18	2					27th June
Yellow Bullock	28	36	16 2	12 15	18	2					11 and 12th June
Do.	28	44	19 12	15 11	24	2					5th June
Swedes (Skirving's) . . .	30	35	24 17	19 14	28	2½					24th May
Green Top Swedes	30	32	17 19	14 5	28	2½					24th May
BROOMHILLS, *Wamphray*											
Green Top Swedes	28	37	19 1	15 2	30	3					27th May
Yellow Bullock	28	38	22 8	17 15	20	3					9th June
Green Top White	28	35	26 16	18 17	20	3					9th June
ANNANBANK, *Johnstone*											
Swedes (Skirving's)	28	32	26 16	21 5	20	2					13 to 16th May
White Globe	28	32	16 2	12 15	15	2					27th June
Do.	28	35	24 10	19 8	16	2					10th June
Hardy Green	28	35	26 12	21 2	20	2					7th June
Yellow Bullock	28	33	18 4	14 8	20	2					17th June
Do.	28	33	18 11	14 14	20	2					6th June
BARNHILL, *Kirkpatrick-Juxta*											
Yellow Bullock	30	47	19 12	15 11	25	2					5th June
Green Top White	30	38	26 3	20 14	25	2					5th June
WOODFOOT, *Moffat*											
Yellow Bullock	28	43	21 0	16 13	20	2					
White Globe	28	39	21 0	16 13	20	2					
CRAIGBECK, *Moffat*											
Yellow Bullock	28	41	22 8	17 15	24	1¾					28th May
NEWTON, *Moffat*											
Swedes	29½	33	27 5	21 12	24	2			0¾		23d May

The weights were taken in different portions of each field, and those stated in the Table show the average; the heaviest and lightest not being particularised.

The average weights of the whole fields are:—

	Scotch Acre. tons.	cwt.	Imperial Acre. tons.	cwt.
For Swedes, . .	24	19	19	16
„ Yellow, . . .	21	13	17	0
„ Common, . . .	26	11	21	1

The following turnip crops were inspected and certified by members of the Club, but not by the appointed inspectors:—

Names of Farms, Parishes, and of Kinds of Turnips.	Width of Drill in Inches.	No. of Turnips on 10 Yards.	Weight.		Manures.						Date of Sowing.
			Per Scotch Acre	Per Imp. Acre.	Farmyard Dung.	Peruvian Guano.	Dissolved Bones.	Ground Bones	Bone Meal.	Animal Manure.	
			tons cwt	tons cwt	cubic yards	cwt	cwt	bus	bus	cwt	
Foster Meadow, *Dalton*											
Skirving's Swedes	25½	25	31 11	25 2	10	1¾		20			15 to 17th May
Gillenbie, *Applegarth*											
Swedes	29	30	24 13	19 11	34		4				15 to 21st May
Craighouse, *Corrie*											
Swedes	29	36	25 7	20 2	20	2					27th May
Green Top Yellow	29	38	21 16	17 6	20						16th June
Purple Top Do.	29	48	30 15	24 8	20						16th June
Goodhope, *Johnstone*											
Skirving's Swedes	30	33	32 7	25 13	30	2				5	15th May
Purple Top Yellow	28	29	30 9	24 3	25	2		20			16th May
Red Top White	29	30	32 2	25 9	25	2				5	17th May
White Globe	29	30	33 11	26 11	25	2				5	17th May
Hardy Green	29	31	42 19	34 1	25	2				5	17th May
Kirkbank, *Johnstone*											
Hardy Green	26½	37	37 15	29 19	26½	1½					21 and 22d May
White Tankard	26½	37	40 3	31 17	26½	1½					18 and 20th May

Report on the preceding Table by the Lockerby Farmers' Club.

The appointed inspectors, viz. Messrs Carruthers, Kirkhill; French, Wamphraygate; Dobie, Kirkburn; Jardine, Milbank; Cattle, Dormont; and Wilson, Daltonhook, proceeded to the examination of the crops of most of the members of the Club on the 17th and 18th November, and the weights now reported were all taken by them before the 25th. Those in the last Table were not examined by the inspectors, but by members of the Club, not the owners of the crops; and the results are here inserted by request, for the sake of further elucidation.

At the request of the Club, at their meeting on the 20th November, the following report is drawn up, containing the substance of the observations made by the inspectors, and the opinions generally expressed by the members at that meeting,

The Table comprehends the farms of twenty-two members of the Club; and of the whole fields weighed, only seven were in the proprietors' occupation.

General character of the crop.

The crop of 1851 falls far short, in point of weight, of those of 1849 and 1850, as will be seen by the following statement of the average of the whole farms taken in those years, viz.:—

	1849.		1850.		1851.		
	Tons.	Cwt.	Tons.	Cwt.	Tons.	Cwt.	
Swedes, ...	21	16	24	9	19	16	Imp. acre.
Yellow, ...	20	2	19	14	17	0	"
Common, ...	22	7	25	14	21	1	"

And taking the three sorts of turnips, the deficiency of 1851 is below 1849 ten per cent, and below 1850, seventeen per cent.

This, in the opinion of the majority, corresponds nearly with the actual deficiency of the general turnip crop in the district, though some think that the proportional shortcoming in the crops unweighed is not so great. It may be observed that the deficiency has to a small degree been compensated by a somewhat larger breadth sown, the extent yearly increasing in the district. The diminution of weight arising in the face of improved cultivation, evidenced by greater quantity and variety of manures and generally earlier sowing, is to be attributed to the stoppage of the growth by cold weather in the end of June and beginning of July, and by the partial attack of insects, when a fortnight was lost and never regained; and although the crop was generally luxuriant and healthy in September and October, there was not time for the bulbs to gain the ordinary size, till checked by the frosts early in November. Had that month been as mild as it was in 1850, and the crop been allowed to stand, it is probable that an average weight would have been attained, great vigour of growth maintaining itself to the last.

The years 1849 and 1850 were considered, on the whole, favourable seasons for turnips in the district; and the crop of 1851 is still, in point of weight, perhaps equal to the average of the six or seven preceding years, though certainly under what those years would have been had the now more improved management then prevailed.

TIME OF SOWING.

It will be observed from the Table that the time of sowing (in all cases noted and readily answered by farmers) is generally earlier than formerly, arising not so much from any particular facility in the season, as from the conviction now prevailing that the chances of a large crop are much greater with early sowing; and this may be particularly remarked in regard to

Swedes—which, when the earlier sown after the 10th of May are better; while after the 25th, or even 20th of May, the chances of weight diminish.

Common, or White Varieties.—It will be noticed that various cases occur, when these have been sown very early, in which the produce has been as large as 30 to 35 tons the imperial acre. The general attention of the district has been attracted by these and similar results last year; and there is no doubt but the practice will be extensively followed, and probably with great profit. Some of the early crops, such as on Hardgrave and Dalfibble, were, previous to the general inspection, all consumed, but were ascertained to be upwards of 40 tons per Scots acre; while it is also stated that, as early as the 15th of September, some crops reached 30 tons per Scots, or 24 per imperial acre. The advantage of having so large crops to consume during October is very great, as

stock of every description advance with the greater rapidity at that mild season with a full allowance of turnips. Some farmers propose a partial sowing as early, if possible, as the 1st of May, reckoning to have their turnips for October sown by the 20th.

Yellow.—The results this year do not show much difference, if sown by the 10th of June; but in every variety, in sowing after the 14th, the inferiority is very marked. If any turnips are sown after that date, it should be the white.

It is scarcely necessary to observe that, however late the sowing be delayed, it is indispensable to have the land thoroughly worked and pulverised, and in a dry, friable state.

WIDTH OF DRILL AND SINGLING.

The width of drills is now, it will be seen, very uniform, varying from 26 to 29 inches. It has been remarked by some farmers that, in cases of full and varied manuring, turnips, especially swedes, on low or sheltered land, or in narrow valleys where there is little circulation of air, would this year have been larger had not the luxuriance of the shaw, causing a closeness of the drills, continued all October to exclude the air and sun. There seems no doubt but that widths of drills, varying from 26 to 30 inches, or even more in the case of swedes, are required on richly manured ground, and in little-exposed situations. The singling now on many farms approaches nearer the standard of 12 to 14 inches, exemplified by the practice of Mr Elliot of Hardgrave, in the two preceding years' weighings; and this would have been more generally adopted, and with much advantage, had not the cold weather, and the unhealthy appearance of the crop at the period of singling, created a hesitation in risking a width so much beyond ordinary practice.

QUALITIES OF SEED AND VARIETIES OF TURNIP.

The complaints of imperfect and mixed seed have been very general this year. The irregular shape of the bulbs, and more than usual proportion, in many fields, of stalks running to seed, as well as a mixture of sorts, are unquestionably more general than heretofore. As the easiest remedy for this, it is strongly recommended to raise their own seed from selected bulbs. Several neighbouring farmers might join and accomplish it with very little trouble.

In noticing the different sorts of swedes, Skirving's purple-top is the heaviest, and indeed the purple-top this year is very marked in superiority over the green. The latter is the hardier turnip against frost; but, as remarked last year, now that storing before frost is more practised, both yellow and swedes of the purple-topped sorts may be more increased in proportion to the hardier

sorts. Of the white sorts, the hardy green is preferred by all farmers who have tried it this year. They are the best shaped, appear more firm and solid, and in October attain a greater weight than any other. Some of the inspectors expressed a decided opinion that on many farms yellow should be further reduced in proportional extent to white and swedes. It is to be noticed, however, that, when stored, they keep fully as well as swedes. They do with later sowing; and where slicing is not practised, they are the best turnip for hoggs in January, February, and March. As the proportion raised for consumption in early winter increases, white will further supersede yellow; and when the use of the turnip-cutter for sheep in spring becomes more general, swedes will also encroach further on yellow on the best soils.

MANURE.

On a large number of farms the mixture of farmyard dung with both guano and bones is now practised, influenced, no doubt, by the great crops on Hardgrave under this system. The result, as appears by the weighing, is very satisfactory; and it is believed that in future, bones, both rough and dissolved, will be more generally used with guano and dung.

In some cases farmers themselves dissolve bones with sulphuric acid. They are sure of getting the material pure, and at a considerably cheaper rate—the cost of dissolving being only 1s. 3d. to 1s. 4d. per bushel. On one farm, along with equal quantities of dung, 11 bushels of dissolved bones, costing £1, 18s. 6d. per Scots acre, was compared with 2 cwt. of guano and 6 bushels of dissolved bones at an expense of £2, 1s., and the former yielded the superior produce.

It will be noticed from the weighings, that so convinced are the farmers of this district of the advantage of adding extra manures, that it is now rare to find any turnips where at least 2 cwt. of guano per Scots acre is not added to the dung that can be spared; and its use has been largely encouraged by the confidence entertained of its quality, in consequence of its analysis by the Highland and Agricultural Society's Chemist, which was reported, under the sanction of the Club, to the public.

The Club, on a previous discussion, expressed an opinion that 40s. per Scots acre, or 32s. per imperial acre, might be profitably expended on extra manures, when 15 cubic yards of dung only can be applied. The result of the weighings in this, as in former years, confirms this opinion, even putting the smallest value on turnips which the present extreme low price of beef warrants. At the same time it may again be repeated, that the best mode of attaining permanent fertility in the soil is to increase the farmyard manure, and to raise the turnip crop with a sufficient quantity of extra manure, to admit of at least one-half of it to be consumed in the homestead.

It may be again noticed that this Table and these remarks will convey information more useful to the neighbouring farmers, conversant with the localities and soils of the different farmers, than to strangers.

The members of the Club are strongly impressed, that were a practice of weighing similar to the above occasionally followed in other districts, much knowledge, practically useful to the country, would be obtained, and perhaps more than by the continuance of the practice in one district. At the same time it is trusted that in future years the Club will follow out the system, though probably the mode may be varied, so as to show more minutely than hitherto the comparative experiments of individual members. Several of them, indeed, have already made varied experiments, but in the present form of publication they could not be reported.

The Club have been kindly favoured with the annexed monthly register of temperature and rain of the vegetating season of turnips, correctly kept at Applegarth Manse, in the centre of the district, from 1st June to 1st December in each of the three last years, and it may possess interest in conveying a knowledge of the climate of the district in the years to which these and our former Tables of results refer.

Months.	1849.		1850.		1851.	
	Temperature.	Rain.	Temperature.	Rain.	Temperature.	Rain.
June, ...	53.3	0.72	57.6	2.27	54.4	2.09
July, . .	57.0	3.40	59.4	2.95	56.0	2.20
August, ...	56.7	3.57	55.1	3.91	55.2	3.38
September, . .	53.5	2.16	51.6	2.43	54.0	1.30
October, ...	44.0	3.25	44.2	1.79	47.8	2.65
November, . .	42.0	2.69	43.1	4.20	37.25	0.67
Mean of the 6 months,	51.08	2.63	51.83	2.92	50.77	2.04

The temperature was taken at 9 A.M. and 9 P.M.

On the PROPERTIES of CLAY MOST SUITABLE for MAKING DRAINING TILES and PIPES.

By Mr Robert Boyle, Tile Manufacturer, Ayr.

[Premium—The Gold Medal.]

At the present time, when draining materials are of so much importance, and their application so essentially necessary as a preparatory step to all good farming, the manufacture of them should be gone about in a regular and systematic manner, which, when practised, its effects may produce a permanent character.

The selection and the preparation of clays for the manufacture of draining materials have hitherto been altogether overlooked, or spoken of so disparagingly by many, as to lead to the supposition that they are not of the slightest consequence. But unless the component parts of clays are thoroughly known, and the preparation it requires, before being made into a tile or pipe, be carefully attended to, the articles made from it will not withstand the induration necessary in the kiln, so as to insure their permanency. It cannot, therefore, be too much impressed upon the minds of those who are immediately concerned in this most important matter, that this preparatory step should never be neglected amidst the almost overwhelming mass of incongruities connected with the subsequent parts of the process.

Thus premised, I will endeavour to point out in a plain and distinct manner what is requisite in the selection of a clay-field, and the modes of preparation necessary to produce a useful and durable article from clay.

In the first place, then, before the erection of tileworks, it is of the utmost importance that landowners should have their estates inspected by a competent judge, so that the best field of clay may be selected as the site of the proposed manufactory.

Much inconvenience, and sometimes great loss, have arisen from sites having been chosen hurriedly, and without duly ascertaining the quantity and quality of the raw clay.

I have known vast sums expended in the erection of tile establishments on the casual report of persons employed in the common operations of husbandry, who have concluded from the appearance of the soil, after being turned up, that abundance of the necessary material lay embedded below; whilst it ultimately turned out that the substratum, a few inches farther down, was entirely useless for the purpose.

On the other hand, good fields of clay have been entirely overlooked from the appearance which the actual soil presented. I therefore repeat that an experienced individual should be em-

ployed to investigate thoroughly the whole extent of land intended to be occupied by the future operations.

It has been much practised, I understand, in many localities, when searching for clay, to use only the boring-rod, and to have the operation conducted by parties who have no practical knowledge of the business whatever; but this in no case should be resorted to, as the spiral motion given to the auger will to a certain extent so amalgamate the different strata which are pierced, that even an experienced eye cannot distinguish which clay is suitable, and which not. In all cases where such a narrow inspection is so essentially requisite, digging trenches with spades should be the only method resorted to. A staff of stout labourers, provided with spade and mattock, should accompany a person thoroughly versant with all the constituent parts of a good tile clay. Holes should be opened at regular intervals, and so wide at top as to allow the men to go down with facility from 12 to 20 feet, by which the inspector thoroughly ascertains the quantity of available material, and tests the quality of every trench separately as they proceed downward.

When a good seam of clay is obtained in one part of a field, operations must not be therefore suspended, and it taken for granted that the whole will be of the same character throughout, as I have sometimes seen one hole dug in a field, and a good depth of excellent clay obtained, which did not extend to more than eighteen feet square, and beyond that space the substratum was devoid of even the semblance of clay.

I may mention a circumstance which I believe is not generally known by tilemakers, that all alluvial clays have been deposited into basin-shaped hollows, deep in their centre, and gradually becoming shallow to the extremities. I am at present working two fields of clay, which at the bottom of the basin is 20 feet deep, but which gradually become shallower as they extend outwards, to only a few inches of depth.

I am also working other fields of clay, where a great many trap-dykes intervene, which are in general many feet broad at the bottom of the seam of clay, but gradually taper to a point as they approach the surface of the ground. I merely mention this, that those in pursuit of clay may not rest satisfied with a superficial mode of exploring such a hidden treasure as clay, which, when brought to light, amply repays all the trouble bestowed on its search.

Strong, retentive clays, which are embedded not far below the surface, at the depth of, say, from three to six feet, are generally the best adapted for pipe and tile making, being soft and unctuous to the touch, readily absorbing and easily parting with moisture.

A very fine clay is sometimes found lying a good way below the surface, in horizontal strata, with alternate layers of fine sand—so fine indeed, that it has a muddy appearance. This clay is gene-

rally soft in its bed, and if immediately subjected to the influence of the pug-mill, will get softer as the process goes on; and if moulded in this state, will long retain the natural moisture, shrink very much in drying, and consequently make a very inferior article. But if this kind of clay be taken from the pit, where it naturally lay embedded, and exposed for a length of time to the action of the air, fissures will appear through it, and all the natural moisture escape from it; and although again saturated with water, it will not imbibe more than is necessary to bring it into a proper consistency; and when moulded into a tile or pipe, will shrink little in drying, and have great solidity after being burnt.

The best clays are those which are solid in their bed, which take a good deal of water to mollify them, have a tendency to stiffen in the preparation, and require no foreign ingredient to be incorporated with them. Tiles and pipes manufactured from this description of clay have great density, shrink little, and maintain their superiority throughout.

Clays requiring any foreign ingredient can never be so intimately united with it as in the natural state; consequently the article manufactured from them will not possess that durability so essentially requisite.

Good clays are found of all colours. The alluvial or carse clays are generally very free of stones; and they are frequently of a bluish tint, though sometimes rather weak in their nature.

Clays of a higher formation are more or less interspersed with stones, are generally of a reddish-brown, but strong and durable.

All clays to be manufactured into articles to withstand the action of the air, should contain the oxide of iron, the ingredient which gives to clay a reddish colour when burnt, and the slight vitrification of which makes the material close in the texture, so that the manufactured article will not readily absorb moisture, and of course will retain its purity in all climates. Clays much devoid of the oxide of iron appear white after undergoing the process of burning, and are therefore only calculated to withstand an intense heat. These clays cannot be made fusible with any degree of heat that can be applied, consequently articles made from them can only be made available for building the inside of air or blast furnaces; and bricks, tiles, or pipes, when manufactured from this description of clay, will not withstand the action of the air. By their porosity they readily imbibe moisture, and expand with frost, and consequently crumble down to pieces.

When clay of a suitable quality is found on an estate, that can be made into tiles or pipes, its *quantity* should be carefully ascertained to warrant the proprietor in fitting up the necessary erections for their manufacture. By making the following simple calculation, such a mistake will be easily avoided:—

An acre of clay, at one foot deep, will make one million of

common-sized draining-tiles, three inches wide and twelve inches long; and taking the average distance at which drains are cut apart at twenty-four feet, there will be consumed 2281 tiles per Scotch acre, or 1815 per imperial acre; hence an acre of clay, one foot deep, will drain 438 Scotch acres, or 550 acres imperial. Thus we see that a field of clay of considerable extent, and the quality good, is of great pecuniary value to a landowner.

Many estates throughout the kingdom are, however, destitute of such clays; and, in cases of this kind, tiles or pipes have either to be carted a considerable distance, or draining materials used not so well suited to the purpose.

In all districts where no fine clays can be found, but where plenty of very coarse stony or sandy clay can be got, it should be narrowly examined, to ascertain whether the expense of removing the stones, &c., would be warranted in a pecuniary point of view. There can be no doubt that many clays may be made available for pipes and tiles that are considered wholly unfit for the purpose. But before entering upon the process, an estimate should be made whether the pipes can be produced economically in the circumstances.

A shortsighted landlord in Ayrshire, whose estate was much in want of draining, refusing to comply with the urgent requests of his steward to establish a tilework, gave, as the only reason for his refusal, that unsightly holes would be made in the field out of which the clay would be taken; when the steward replied, that if tiles were made, and the whole estate drained thoroughly, in half a century the increased produce will have filled all the unsightly holes with gold. I am not sure that the steward's opinion is so utopian as it appears at first sight.

One thing essentially requisite in the selection of a site for a tilework, is to secure a proper level for carrying off the superabundant water, which, in low marshy situations, is so detrimental to clay being properly wrought. When it can be accomplished, a secure drain should be placed as near the bottom of the seam of clay as circumstances will allow, and so formed that the water may be retained or let off when necessary.

Before commencing operations, the soil and all extraneous matter should be removed from the top of the clay, no organic matter being allowed to remain, or the tenacity of the clay will be lessened, and the articles produced from it will not emit that metallic sound which is the sure indication of an indestructible article.

The season most generally adopted for raising the clay is the winter months, when most other field operations are suspended.

Turning the clay repeatedly over in winter, and exposing it to frosts and thaws, will be found very beneficial.

Much has been said of late in regard to taking clay from its natural bed, and immediately subjecting it to the moulding

process without any preparation. This theory has emanated from some recent inventors of tile and pipe machines, and is recommended by them as an inducement to purchase their machines. To practical persons, however, this theory is known to be untenable.

The most casual observer has no doubt frequently perceived inequalities on the surface of draining-tiles, and at the same time observed that, when broken, such tiles are internally interspersed with seams of white matter. Both the unevenness and variation of colour arise from the clay not having been incorporated before the moulding process took place.

Clay embedded in low marshy situations, more especially that found below moss, has, when taken from its bed, such a fine uniform plastic appearance, as to induce people of limited experience to conclude that it can be put into the pug-mill without any preparation; but nothing can be more erroneous than such a mode of procedure.

It should be borne in mind that clays, as they lie embedded, are not uniform in their composition. Even the very finest of them have different portions of matter flowing irregularly through them, and are more or less intersected with hard lumps, which, when acted upon separately, require different degrees of heat; so that if the clay be taken as it lies, and immediately subjected to a uniform temperature in the burning process, the result will be, that the manufactured article will be shrivelled and uneven.

But if the different ingredients of which clays are composed are intimately and minutely mixed before being subjected to the moulding process, we may confidently expect to have a superior article, regular in all its parts, and of equal consistency. Hence the necessity of paying the utmost attention to the proper incorporation of all the component parts of raw clay.

To accomplish this desirable object, it has generally been the custom with tile manufacturers to raise, during the winter months, the clay intended to be made into tiles the following summer; and the operation is as follows:—

A space is marked off, and all the soil and subsoil cleared away from the top of the clay. A cut of the clay (say about a yard in breadth, and the length of the space cleared) is first thrown off, descending to the bottom of the seam, if not deeper than from six to nine feet, and this is left as an empty space for the next trench to be thrown upon, and so on to the end of the space marked off. This part of the process should be done carefully and systematically, as many of the errors committed may be traced to the slovenly manner in which this has been performed.

The clay should be cut with the spade into very thin slices, so as to expose the largest surface to air and frost. After lying some time as thrown off, the mass should be turned repeatedly from top to bottom, mixing the whole as intimately as possible.

During this operation, as much water should be given as the workmen think it will require to bring it to a proper consistency. The heap should then be levelled and smoothed on the top, and covered over with turf or straw to preserve it from rain and drought.

Still, with all this precaution on the part of the manufacturer, small lumps will be found through the clay, which no saturation in water, however prolonged, will dissolve; and these lumps, left undissolved, form one of the many inconveniencies which beset the tilemaker.

There are two or three ways in which this difficulty may be obviated. The first, and certainly the most complete plan, is the method I have practised these many years at one of my potteries, in preparing the clay for making articles of domestic use, spigot and faucet water-pipes, &c. The clay, after being taken from the pit, is thoroughly dried, then dissolved in water, and stirred up till it be brought to about the thickness of rich cream, after which it is strained through a fine brass sieve, of from fifty to seventy wires in the inch, thus getting quit of all extraneous matter. The water is then evaporated either by exposure or artificial means, till a regular consistency is obtained for working the clay, which is then close in the texture, smooth on the surface, and after being burnt will ring like bell-metal. This process involves a considerable expense, and is considered by many too expensive to be adopted in the manufacturing of tiles or pipes for common furrow-drainage.

Another and effectual method can be more easily practised in a common tile establishment, which is, instead of raising the clay in the winter months, and immersing it immediately amongst water, it should be dug in the course of the summer, and put up in thin layers in an exposed and airy situation, the spadefuls being laid up so as to have a free circulation of air amongst them. In this way all the natural moisture escapes, fissures made, and the whole becomes quite dry. Then, when the rainy season approaches, the mass expands, effervesces, and crumbles to pieces; and the lumps, which no saturation in water, however prolonged, can dissolve, become, between the alternations of drought and wet, transformed into minute particles. Then, by turning the whole mass over repeatedly prior to using it, it will be thoroughly incorporated, and secure the durability and good appearance of the article produced.

When clay is subjected to this process, comparatively little loss in the drying or burning is incurred—the tiles being produced without shrivelling or twisting.

The superior efficiency of this method of preparing the clay to that commonly adopted by the tile-manufacturer cannot be disputed; and it is rather remarkable that nowhere in the course of my peregrinations have I seen it systematically adopted.

The principal recommendation of the usual method is, that it employs the men at a season of the year when other operations of a tile-work cannot be carried on. The superior advantages of this improved method, it is hoped, will induce our spirited manufacturers to adopt it.

By raising the clay in summer, and subjecting it to the process I have described, besides being the most effectual for dissolving the lumps which are naturally interspersed through the seam, it secures another great advantage to the manufacture of small pipe-tiles, by separating the stones and other extraneous matter from the clay, previous to its being pressed through the dies of a tile-machine. In England, where the small thin tube of one inch bore was first introduced for draining purposes, it was found expedient that their manufacture should be conducted in such a manner as to insure a proper channel for the water to flow in an even unbroken current; and an article that is necessarily so small as a tube for common drainage purposes, should have a smooth uniform conduit, so that nothing may retard the run, or serve as a lodgment for any sediment that may find its way into the tube.

In the making of pipe-tiles with machinery, as in every other new invention, many difficulties had to be encountered in the manufacture. Early attention was necessarily directed to cleanse the clay from all impurities, especially in those localities where clay naturally fine could not be had; but nothing effectual, and at same time economical, was for many years adopted. In Norfolk, Suffolk, Kent, and Essex, an attempt was made to *wash the clay* from all impurities—a process somewhat similar to what I have mentioned as being used about potteries—but at that time the expense seemed so formidable that it never came to be generally adopted. About small establishments, the apparatus for effectually washing the clay, and the necessary labour attending it, erected a complete barrier against its adoption.

As every attempt to obviate the pressing evil should be made public, I will, in a plain manner, endeavour to describe the most economical method of washing clay, and of bringing it into the fittest state for the manufacture of small tubes.

Before commencing to wash the clay, a suitable spot must be selected upon which to erect the necessary apparatus. A small piece of table-land, with the ground gradually rising behind, and sloping downwards in front, if such can be found, will be the most eligible. A circle of about 9 feet in diameter is first marked off, and bedded with hard-fired bricks laid on edge; a wall is then raised round the circle to the height of 3 or 4 feet, and a second one is also raised the same height, 4 feet within the outer one—the spaces between the walls forming the vessel in which the clay is put to undergo the process of washing. An upright spindle is then fixed in the centre of the circle, from which three strong arms are extended to the length of the outer wall. To one of

these arms is attached an iron roller, which moves between the walls, and to the other two arms are attached implements of iron similar to a harrow. A horizontal pole is then attached to the extreme point of the upright spindle, and extending a good way beyond the outer wall, and by which a horse moves the harrows and the roller round the circle. A stream of water must, if possible, be conducted by a pipe into where the washing is performed, which can be let off or on as required. The clay, which of course must have been previously turned over and properly mollified, is then wheeled by the workmen into the washing-circle, and a sufficient quantity of water let in upon it. The horse then moves round the rollers and harrows—the former pressing downwards, and crushing the lumps, the latter raising up and separating the mass; and thus both act alternately till the whole contents assume a pulpy appearance. A close grating or sieve, one foot square, is fixed at the one side of the washing-circle, and is protected by an iron sluice whilst the operation of washing is going on. When the washing is completed, the sluice is opened, and the water holding the clay in solution runs through the sieve, whilst the stones and other extraneous ingredients are retained within the circle, which is then cleaned out by the workmen, and more clay put into it; and the same operation is repeated, till a sufficient quantity of clay has been washed.

A space of ground contiguous to the washing-circle must be formed into a receptacle for the dissolved clay after it passes through the sieve, having an inclination of at least 4 feet below where the washing is performed. This piece of ground must be carefully hollowed out, and an embankment put round the sides of it to the height of 3 feet; and around its bottom must be a close and efficient drain, to draw off the superabundant moisture. The pulpy clay, when run into this receptacle, will very soon settle down towards the bottom, the water remaining at the top till evaporated, and the clay attain that consistency which is most suitable for pipe-tile making. To assist the evaporation, small ruts may be formed along the top of the mass to convey the moisture to one common point, where it may be run off to the lower extremity of the field.

The most suitable season for conducting this washing is in the winter months; and when the spring approaches, the clay will have become so consolidated that pipe-tile making may be resumed at the usual period.

To prevent the washed clay from getting hard and crusted on the top during the drying months of spring and summer, a layer of fine sand should be spread over the top, which, if required, can be mixed amongst the clay when carried to the mill; or, if found inexpedient to do so, it can easily be laid aside for further use.

When clay is subjected to this ordeal, its quality will be very

materially enhanced, (apart altogether from the mere taking out of the stones, &c.,) as all the different ingredients of which clays are composed will be intimately and minutely mixed, so that no undue shrinkage nor shrivelling will be observable in the body of the manufactured article; consequently the waste will be but trifling in comparison to what takes place with the usual routine of a tile-yard.

It has always been a subject of general complaint by practical drainers, that small tubes are invariably twisted, and that consequently much difficulty arises in securing a proper conduit with them at the bottom of the deep drains. This evil, however, would be greatly modified, if not altogether obviated, by the washing process.

It is also of the utmost importance that the external and internal parts of a pipe-tile be made smooth and glossy, which will secure it from imbibing water and expanding by frost, and will serve also as a preventive from the inner surface of the tube accumulating any incrustation. Both desirable properties will be fully secured by properly washing and separating the extraneous matter from the raw clay.

In London, where brickmaking is carried on to a great extent, steam-power is sometimes applied to this washing process, by which a quantity of clay is made soluble, and passed through the sieve in one day, which is sufficient to make 60,000 bricks.

In pipe and tile establishments, therefore, where steam-power is used to drive the machinery in the tilemaking season, the same power might be made available in winter to drive the washing apparatus.

Although the washing of clay has hitherto seemed a formidable operation, incurring a considerable outlay at first, and much labour in the process—so much so, as might lead people to think it altogether unwarranted in a small tile-yard—I am perfectly convinced, that in a large establishment, where there is a demand for small tubes, the superiority of the article manufactured from washed clay, over that which is not washed, the small amount of breakage, and the additional price they obtain in the market, will about counterbalance the outlay incurred in the washing process. The method of cleansing the clay by washing as I have described is, undoubtedly, the most effectual, and when used for the manufacture of small pipes, will be found to possess many advantages which are not attainable by any other method. But where only a limited supply of these small pipes is required, it may not, in a pecuniary point of view, be thought advisable to adopt such an extensive process of the refinement of the clay.

Having heard so much about washing clay, as practised by tilemakers south of the Tweed, and particularly by the brickmakers around London, I visited some of the brickyards near London, and saw how the process was carried on there, which

is performed on a similar principle to that which I have described.

The washing, or rather the mixing the clay, is principally performed by the brickmakers of London by having certain ingredients mixed in the mass, principally chalk, so as to give the bricks as near the colour of stone as possible for particular buildings; but when clay is mixed with chalk or lime, great care must be taken in the burning process.

I may remark here, in passing, that there is a process going on, and ingredients used in some of the London brickyards, which serve two purposes, and which cannot be surpassed in an economical point of view. Coal-ashes, or, as they are termed, *breeze*, are collected and submitted to the action of bruising rollers, for pulverisation. They are then mixed amongst the brick clay to the extent, perhaps, of 10 tons to 300 cubic yards of clay. The bricks, when thoroughly dry, are put into clamps, built 33 rows in height. There is no fuel put between the rows of brick, except with the 3 bottom rows, as there is as much of the breeze interspersed amongst the bricks as to burn them thoroughly. After the clamp is set fire to, it will take one month before a regular heat come to the top. The bricks at both ends are then taken down, the external air forcing the fire inwards till the fire meet in the middle of the clamp, and all are thoroughly burned; but this is a digression from the subject in hand.

In some of the early introduced pipe-tile machines, such as the Benenden machine, Clayton's, &c., a grating was inserted into the cylinder immediately above the chamber, through which the clay is expressed, to separate the stones from the clay. But with clay of the consistency necessary for the manufacture of pipe-tiles, there is no machine driven by hand which can effectually be wrought so as to separate the stones from the clay, and at the same time press it regularly through the dies.

At the Highland and Agricultural Society's show last held at Edinburgh, Clayton's pipe-tile machine was exhibited, by which both the cleansing of the clay and the moulding of the pipes were attempted simultaneously by manual labour; but the double operation was performed with too much evident exhaustion of the men.

The gratings for cleansing the clay are generally made with longitudinal bars of iron, of the same distance asunder as the thickness of the dies of the machine; but this arrangement has not the desired effect, as every long thin piece of stone will find easy egress through the longitudinal grating. When thin slaty stones occur in the clay in the chamber, they almost invariably present themselves to the dies in such a position as to interrupt the uniform progress of the clay outwards.

Instead of the grates having longitudinal bars, a cast-iron

plate, perforated with round holes of a somewhat less diameter than the thickness of the dies of the machine, should be introduced, and which will intercept any stone in the clay.

Great, however, as the benefit undoubtedly is, in having round perforated holes in the screen-plate, an inconvenience arises from the power required to force the clay through them, which will far exceed that required with the longitudinal bars, thus rendering the double operation of screening and moulding not easily attainable by manual labour. With the greater number of the recently invented pipe-tile machines, the process of cleansing the clay has to be performed by itself, and which nearly takes the same amount of labour as that required for moulding the pipes—thus adding a considerable cost on every thousand produced.

A great improvement in the screening process has of late been effected by Mr George West, Riccarton, Linlithgow, by a simple apparatus to act in combination with the pug-mill, by which the double process of milling and screening is performed with great precision, and at a reduced expenditure.

On the top of the pug-mill, and fixed on its spindle, is a large spur-wheel. Adjacent to the mill is a horizontal box, which at its farther extremity has two receptacles for receiving the clay previous to its being screened. A plate of iron, perforated with holes, is fixed in each receptacle, through which the clay is expressed by pistons acting alternately. The pistons are attached to a strong horizontal shaft, with a considerable length of crank, the whole being set in motion by a wheel acting in unison with the formerly mentioned spur-wheel. The perforated plates used in the screening process are raised up and let down by the action of a screw, when found necessary to be relieved from the stones and lumps which accumulate behind, and which are pushed out by the reciprocal movement of the two pistons. The plates being again let down, the screening is resumed without any delay taking place. The whole machinery of the pug-mill and the screening apparatus are wrought with ease by one horse, and can be erected for £21.

Taking the operation of screening by itself, it can be performed by two stout lads, the one putting in the clay and the other carrying it away, and who are able to cleanse a sufficient quantity to make 10,000 pipe-tiles per day.

An objection might be raised against the screening apparatus acting in conjunction with the pug-mill, inasmuch as the milling and screening together will exceed the power of one horse. This no doubt would be the case, provided the pug-mill was made with the usual number of arms and knives required in one of a common tile establishment, but so large a mill is unnecessary when the screening apparatus is attached to it. The pressing of clay through small perforated round holes, besides removing the stones, reduces the large lumps which may be intermixed, bring-

ing them to a more uniform consistency than can be attained by the internal machinery of a pug-mill. In an establishment where from 20,000 to 30,000 tiles are required to be made weekly, a small steam-power will be found considerably cheaper to drive the pug-mill than horse-power, and it does its work more effectually—and nothing is easier than to adapt steam-power to the pug-mill and rollers.

Tubular tiles for drainage purposes, having undergone a severe scrutiny, are now considered the most efficient and economical material by many of our leading agriculturists. It follows, as a natural consequence, that the manufacture of these small tubes must be conducted in such a manner, and the clay so prepared, as to form an entire and smooth conduit at the bottom of a drain, so as to secure the confidence of the practical drainer.

The generality of clays found in Scotland are very unsuitable for the manufacture of small tubes, when taken from their natural bed; hence the necessity of adopting some method of ameliorating them, and excluding extraneous matter from them. The old method of preparing the clay is in many instances still adhered to in common tile establishments, when endeavouring to make small tubes; but it is very inadequate for the purpose, and the article produced must be very inferior. An entirely improved and systematic arrangement must be adopted through the whole process of the manufacture, or we may rest assured that no tiles will emanate from it possessing a permanently useful character.

In the common method of preparing clay, if any lumps should remain undissolved, or if small pieces of limestone be in the clay, bruising rollers will be found very advantageous, to be used previous to the clay being put into the pug-mill. The action of the rollers will crush these ingredients into such minute particles, and the mill so diffuse them through the clay, that no bad effect will be observable in the manufactured article. But if nodules of limestone be allowed to remain whole amongst the clay, and be made up into the tiles or pipes, and although not observable when newly burned, they will, whenever damp comes into contact with them, expand, and cause the tile to crumble to pieces.

The rollers I use are 18 inches long and 12 inches in diameter, and are placed in a cast-iron frame, with a box on the top, into which the workmen put the clay which the rollers catch as they revolve. An endless web is immediately placed below the rollers, which the clay drops upon, and is conveyed by the web and emptied into the pug-mill.

The construction of a pug-mill is so generally known that a minute detail is unnecessary. I may only mention, that when steam-power is used instead of horse, a larger number of *knives* and *arms* can be introduced into the mill, and a greater pressure applied, thereby bringing the clay to a more uniform consistency, and producing a greater quantity in a given space of time.

When the engine has plenty of power, the pug-mill may be put down in a horizontal position, which will be found a convenient one for having the bruising rollers placed immediately above it, so that the clay may drop from the rollers of its own gravity. Where bruising rollers are not used, a horizontal position is considered by many as convenient for the purpose of emptying the clay from the barrows at once into the mill, thereby saving the labour of one person; but this is questionable economy. I am of opinion that no clay should be emptied loosely in large masses into the mill, but should be introduced into it in single spadefuls, thereby securing an equal distribution in the mill, and a regular pressure upon it downwards.

It is a common practice in many tileworks to take the clay from its natural bed, and immediately tumble it into the mill, when many parts of the mass must be hard and lumpy; the workmen thinking to mollify it by throwing water upon it whilst in the mill, which only increases the evil greatly, as the wetted clay either slips through without being properly acted upon by the knives, or the wetted sides of the cylinder cease to resist the pressure from the arms and knives, in consequence of which the entire mass of the clay revolves round with the spindle, the machinery thus ceasing to make a proper amalgamation of the clay, which issues from the mill in a loose and unincorporated state. If the clay were wheeled in, and beaten up in a batch around the mill, some time previous to its being used, its quality would be materially improved, as the dry parts will have absorbed moisture from the wet ones, causing a uniform moisture through the heap; and if the pugged clay were beaten up into a mass for a considerable period before being used, its composition would become more homogeneous.

Something similar to the above method in kind, if not in degree, is found indispensably necessary in porcelain manufactures. The longer the ingredients from which the fine porcelain is manufactured remain in contact before being used, the sounder and better is the article produced.

The Chinese, who were long famed for the manufacture of fine porcelain, seemed to be fully aware of the great benefits resulting from having the united ingredients piled up for a long period before being used, sometimes extending to nearly half a century. Many potters in China, knowing well that they could not leave anything more valuable to their descendants, have bequeathed them as much of the prepared material as would serve an ordinary lifetime.

There is a particular kind of clay, of which I have had a good deal of experience, that requires a different mode of preparation to those clays more generally in use. This clay, in appearance, is similar to the shales of the coal formation, but is strongly impregnated with the oxide of iron, and is generally found in deep strata. It is hard and brittle, and seemingly devoid of the unctuosity pos-

sessed by other clays. It lies pretty solid in the bed, requiring the use of the pickaxe. When newly dug, it rises in lumps, and will not dissolve readily by the action of the atmosphere, or of water. When dissolved, however, (which is most readily accomplished by artificial means,) and properly mixed with the soft unctuous clay generally found above it, a very desirable article is produced from it.

On the extensive estates of the Earl of Derby, Knowlesly, near Liverpool, there is a very large field of this kind of clay, upon which, under my direction, an extensive tile establishment was erected some time ago. The tiles which I manufactured from it were excellent in quality and very durable. As it may be of use to those proprietors who may have clay of the same kind, I will describe the method which I adopted for preparing it previous to its undergoing the moulding process.

The soft clay is taken off the top and wheeled aside. The hard, lumpy, brittle kind, is then raised and put through two pairs of powerful bruising rollers. These rollers are set in a cast-iron frame, one pair being placed immediately above the other, that the clay may drop from the upper ones into those below of its own gravity. The upper pair of rollers are placed considerably wider than the lower, that they may the more readily receive the larger lumps. The lower ones are placed so as they can be regulated according to the fineness of the clay wanted. These rollers may be either set in motion by steam or horse power. When by steam, which is the most effectual method, a lying shaft is connected with the engine to drive the rollers, which are placed adjacent to the clay-pit. The clay passes through the rollers very quickly, and is then wheeled out and mixed properly with part or whole of the soft top clay.

This process is performed in the winter season; and when the tilemaking season approaches, the prepared mass is subjected to the action of another pair of rollers, which empty themselves into the pug-mill by an endless web. This grinding and mixing, no doubt, creates a great deal of extra trouble, and adds considerably to the expense of manufacturing the tiles, but, when conducted in a proper manner, this clay makes a very durable article.

There are many places where clay of the above description has been overlooked, and hitherto considered impracticable for the manufacture of draining materials.

In localities where no other kind of clay exists, and softer materials are at a great distance, the above plan may be adopted with considerable advantage by the proprietor.

On one of the Marquis of Bute's estates in Ayrshire there is a very large field of clay of this kind, although not so strongly impregnated with the oxide of iron; and on it erections were put up, and the manufacture of tiles, by the *usual* process, attempted. The result however, as might be imagined, was a complete failure, and the work abandoned.

As no other field of clay could be found in that locality, and as the estate was much in want of draining, the failure was a source of deep regret to the late noble Marquis. In the emergency I was applied to, and suggested and put in practice the above plan, which has been in operation for some time; and, if carried on skilfully and systematically, a large supply of excellent draining materials might be the consequence.

The large bank of clay on the road from Newcastle to the Staffordshire potteries, out of which the well-known blue-coloured water-pipes, bricks, and draining-tiles are manufactured, is similar in appearance to that I have been describing. The Staffordshire clay is taken from a bank considerably beyond one hundred feet in depth, and it undergoes the operation of grinding between rollers previous to its being manufactured.

On the Liverpool and Birmingham Railway, the traveller cannot fail to be much struck with the beautiful and enduring appearance of the bricks used in the construction of the different bridges near Whitmore Station, which are all manufactured from the above kind of clay.

An estate of large size, having no tile establishment, and having the draining materials carted from a distance, incurs a considerable yearly expenditure. It is, however, reasoned by many proprietors, that as the tenants cart all the materials, the expense does not fall upon themselves; and hence they do not exert themselves to make that material available, which perhaps lies embedded below the surface of their estates, and which, by a judicious arrangement, might no doubt afford mutual benefit to landlord and tenant.

It is of paramount importance at the present time, when everything connected with draining is invested with peculiar interest, that correct views should be disseminated regarding the nature of clays, and any artificial process which may be recommended for their improvement; and, as regards the latter, nothing should be attempted to give *certain qualities* to clay which it does not naturally possess, unless it can be simply and economically done. I am tempted to make this remark in order to counteract certain theoretical notions which have lately appeared regarding mixing clays with *foreign ingredients;* or mixing two clay-fields which, taken by themselves, are unfit for tile or pipe making, when it is recommended to extract the good clay from each, and make a medium one between them. However plausible this theory may seem to the uninitiated, it can never be carried into practice to the extent they would have us to believe. On the qualities of clay, too, there has been much theory and little practice, and the instruction given on them in the class-room has been confined there, instead of being carried out in the tileyard.

In making small tubes, artificial means must be resorted to with the generality of clays found in Scotland, so as they may pass through the dies of a pipe machine in a satisfactory manner.

A great majority of the clays of England are much finer than the Scotch clays, and free of any gritty substance that retards their progress through the dies of a pipe-tile machine; hence many English pipe-tile machines are unavailable when put in use on the north of the Tweed.

Many of the English clays, being very unctuous, take on a very fine skin in passing through the dies, and hence their small tubular pipes have a very beautiful appearance, compared with those from the Scotch manufactories.

The *round, plump appearance* of the English pipe-tiles is much admired, and exhibited in this country as a pattern of excellence; but it invariably happens that they are very small in the calibre.

Where pipe-tiles are made, means must be used to preserve their round, plump appearance, after they emerge from the dies, other than merely placing them upon a plain board; for upon such a surface their tubular shape will not be retained.

Clay, that it may progress freely through dies, and retain its adhesive quality, must be brought to a certain consistency; but such a state of the clay prevents the pipe-tiles sustaining their own weight, when placed on the shelves of a drying-shed, where they collapse, and crack at the point where the weight more immediately presses upon them.

In placing any truly cylindrical article upon a plain surface, not more than one-twentieth part of its circumference rests upon it, which is a very small proportion to bear the whole weight, consequently plastic material must collapse with such a superincumbent pressure. To remedy this inconvenience, a method is adopted, which in most cases proves effectual, but which of course adds to the cost of manufacturing the pipe-tiles. When they have been some time upon the drying shelves, and their drying forwarded to a degree which will not affect the adhesion of the different particles of which clays are composed, and are able to sustain their own weight, they are taken from the drying shelves singly and placed on a table, and a roller inserted within them. The roller is made to revolve backwards and forwards several times by the motion of a boy's hands till the pipe-tile resumes the tubular form, when it is replaced upon the drying-shelf, to prepare for removal to the kiln. In the rolling process great care is requisite to take the pipe-tiles at the proper time, and to employ a skilful operator, or the evil will be increased instead of being removed.

I have recently adopted a simple method, which I have every reason to believe will go far to supersede the rolling process, and lessen the cost of making, which I will now describe in such a manner as will enable any one to understand the principle upon which it is based.

In making pipes, say of two inches diameter, oblong pieces of wood are taken, two inches on the square, and of such a length as thoroughly to cross the drying shelves. These pieces of wood are

sawn asunder diagonally, and both halves are placed parallel to each other upon the shelves loosely, to form a seat for the new-formed pipe-tiles, which there retain their pristine shape.

These angular-shaped pieces of wood also prevent the pipe-tiles warping or twisting on the drying shelves, which all clays are liable to, however fine, when propelled through the dies of a pipe-tile machine, and thereafter placed on a plane surface.

Collars for draining-tubes, which were for a time used extensively in England, and in some places of Scotland, are now considered by many so expensive, and so clumsy and ineffective, that they are fast falling into disrepute. The cylindrical pipe is alone used in many places, but when small in the tube it makes a defective drain.

To obviate the evils attending drainage with small tubes, a species of bell-shaped pipe-tile has been recently introduced, in imitation of the small water-pipes, which used to be made on the potter's wheel. The bell-mouth is formed on these pipe-tiles in a very simple and expeditious manner, as follows :—The round horse that is used for lifting the pipe-tiles from the machine is formed with a gentle swell towards the end which is next the boy's hand. The boy, after inserting it into the pipe-tile as far as it will easily go, lifts and turns the pipe-tile up till it assumes a perpendicular position, when he strikes the end of the horse gently upon the table, which brings the one end of the pipe-tile a little way over the swelled part of the horse, and forms it into a sort of bell-mouth, which, when burned, becomes a fit receptacle for the smaller end of another pipe-tile to occupy; so that when laid down in a drain, such pipe-tiles sustain one another, and no derangement can take place.

To make good pipe-tiles with a bell-mouth, the clay must be well made—otherwise the strain upon the end of the pipe-tile, in covering the swollen end of the horse, must of necessity cause the clay, however well-prepared, partially to separate ; and if it be ill-prepared, rents will be the consequence, and the pipe-tile rendered unfit for use. Caution must also be used in placing these bell-mouth pipe-tiles in the kiln, as the swelled portion is apt to get damaged in the burning. Hence bell-mouthed pipes, being joined by weakening an important part, are not what a drainer should desiderate.

Before concluding, I may be permitted to make a few remarks on the clay most suitable for making spigot and faucet water-pipes, on the deposits found in drains, on flowerpots, &c., which, although not strictly relevant to the subject under consideration, may be interesting.

In the bill passed regulating the sanitary condition of towns, a clause empowers commissioners to construct proper drains, in order to remove nuisances from houses, from which a question will naturally arise—how such drains are to be constructed, and what is

the best kind of material to be used in the formation of the conduit.

Freestone has hitherto been much used for common sewers, and even for ordinary drains,—the idea being that that material possesses both indestructibility and efficiency beyond every other. Nothing, however, can be more fallacious than such an opinion. Every drain should be so constructed as to take instantaneously and thoroughly away every refuse from human habitations. The general form of these stone drains, however, are very inadequate for this purpose—they forming a continuation of cesspools, well calculated for retaining filth and engendering malaria.

Circular brick drains have sometimes been resorted to; but they also form bad conduits where despatch is so essentially necessary, since the friction inevitable in a drain formed of *common bricks*, and the lodgment of filth occasioned by rugged edges and corners, form a long series of cesspools throughout the conduit.

Earthenware pipes, both for sanitary and domestic purposes, have hitherto been partially used, and, when made in a skilful manner, are found efficient and economical. A few hints regarding the proper material for their construction, its preparation, and their manufacture, may be of use at the present time.

In the first place, then, clays impregnated with the oxide of iron will be found the best material, provided it is prepared in a proper manner.

Let it be impressed, therefore, on the mind, that all clays to be manufactured into articles to withstand the action of the air, for undergoing a high hydraulic pressure, and remaining undeteriorated under every variation of climate, should be plastic, tenacious, and strongly impregnated with the oxide of iron,—an ingredient which gives a beautiful red tinge when burned, and, when combined with the alumina and silica of the clay, will, by its necessary induration in the kiln, undergo a vitrification sufficient to make the article as close in the texture as marble, and which will not absorb water. This clay being very adhesive, and rendered compact by the process of *sifting* and *boiling*, which I have described, makes it unquestionably the most efficient material for spigot and faucet water-pipes, intended either for sanitary or domestic purposes.

Whilst, however, this kind of clay can be made so efficient by the process described, it is totally unfit for the purpose when used in its *natural state*, and all water-pipes made from it in that state should be rejected.

An attempt has recently been made at different places to produce water-pipes from the common drain-tile clay, taken rough and raw from its natural bed. The very slight preparation it receives by the action of a common pug-mill, the barbarous method adopted in forming the pipe, by bending the clay round a circular piece of wood, and clumsily joining its edges by simply pressing

them together by the hand, (which joining is almost invariably perceptible after undergoing burning,) must render them very inferior. In addition to this, these water-pipes are burned in a common drain-tile kiln, some being hard fired and some soft; so, taking them as they are, it is difficult to conceive how people are induced to use them as a permanent improvement.

Fire-clay pipes are sometimes used for conveying water, but, from the nature of the ingredients of which they are composed, great porosity and want of adhesion render them unfit to stand much pressure, or to resist the alternations of weather which occur in this variable climate.

The porousness of the common furrow-draining pipe-tiles has often been lauded, especially in England, because a certain amount of drainage, it is said, is effected by the percolation of the water through the body of the tube. To burn a pipe-tile, however, as it should be, the more fusible parts of its composition will be acted upon by the heated air of the kiln, so as to close up the porosity, and make it firm in its texture; whereas a porous pipe-tile is one not brought to that pitch of heat in the kiln capable of vitrifying the more fusible parts, and hence parts of it will to a certain extent remain detached, and be liable to separate altogether. Therefore the absorbent or percolating qualities of pipe-tiles are a sure criterion that their permanency cannot be depended on.

I have no doubt that the roots of plants or incrustations being found in the interior of pipe-tiles may be ascribed either to the unsuitableness of the materials, or to the materials being loosely put together and unskilfully manufactured. If the internal parts of a pipe-tile be made smooth and glossy, it will secure it from imbibing water or expanding with frost, and be a preventive against any incrustation, or ingress to the roots of plants. I may, therefore, repeat, that tiles of all kinds can only be rendered durable by properly separating their material from all extraneous matter, and subjecting them to a high temperature in the kiln.

As the obstruction of drains by the roots of plants, incrustation, &c., has recently been brought prominently forward by some of our leading agriculturalists, I may be allowed to direct their attention briefly to what I consider a convincing proof that the obstruction complained of may in a great measure be traced to the method by which drains are formed, and the unsuitable materials placed in them; and to illustrate the subject more fully, I would, in the first place, allude to the manufacture of flowerpots, and show how they conduce either to the *welfare* or *destruction* of the plants placed in them.

All who have had experience of the flower-garden must be aware that, to insure a regular and satisfactory development of plants in pots, they must have them made so as the fibres of the most delicate plant may not recoil when coming into contact with their sides. It is not enough for the practical gardener that the

pots be exquisitely formed and elaborately ornamented; he must have them slightly tapered downward, finished with an egg-shaped bottom, and porous throughout.

The general mode of manufacturing flowerpots is very ill calculated to meet the views of the practical gardener. The clay does not receive a preparation calculated to produce a uniformity in all its ingredients, but is placed unprepared into the hands of the thrower, who, in its manuduction, leaves ridges in the interior, which, in the unpotting of the plant, prove injurious to its tender roots. The greatest evil, however, in all flowerpots which are *finished solely* by the thrower, is the fine skin produced by the friction of his hands, which compresses the plastic material to such a degree that the rind is rendered impervious to the air and water, especially when the pots undergo a high temperature in the kiln. Hence the impossibility of any plant growing luxuriantly in such an impenetrable encasement.

To remedy this evil, I have of late used the turning-lathe in the manufacture of garden-pots. At potteries where the turning-lathe is required to give the finer kinds of ware a nice appearance, (not attainable by the thrower,) an iron tool is used upon the pots in the green state—that is, between the wet and the dry state—to pare away everything superfluous; which operation, while it lightens the articles, necessarily takes away the smoothness which the thrower had given to the outside by the action of his hands, leaving the body of the pot quite porous. This porosity serves as a series of receptacles from which the plant receives its proper nourishment; and hence we perceive the fibres of all plants more firmly matted around the interior of a soft-burned porous pot, and having a more healthy appearance, than in a smooth, hard-burned pot, close in its texture.

From these facts we may naturally conclude, that if water-pipes and pipe-tiles were made with qualities the reverse required in garden-pots, no obstruction would occur either from earthy deposits, incrustation, or the roots of plants.

I hope that what I have said on the best modes of preparing clays will induce landowners to be on their guard in this important process; and I venture to affirm that many of the deficiencies of pipe-tiles and tiles may be ascribed to the preparatory process being carelessly performed.

On the COMPARATIVE ADVANTAGES of FATTENING CATTLE in STALLS or BOXES, and in SHEDS.

By Mr Walter Reid, Drem, East Lothian.

[Premium—The Gold Medal.]

In the lower district of East Lothian the fattening of cattle has for a long period been carried on in open courts, the practice

being, in the opinion of the feeders there, the most suitable for converting the abundant fodder into manure—the system of tying cattle in stalls, or byres, being confined to the higher districts, where the climate is colder, and where the straw bears a smaller proportion to the turnip crop. Believing that the feeders in both districts are so far correct in their respective conclusions, but doubting the propriety of having so much litter trodden down, even in the lower district, where this farm is situated, exposing it to drenching rains, and again subjecting it to the influence of drying winds; and being satisfied that the feeding of a large lot of cattle together is injudicious, even when fed on turnips alone, but much more so when supplied with artificial food, such as linseed-cake or bean-meal, now the general custom—inasmuch as, the greater quantity of nourishment being contained in smaller bulk, the stronger of the cattle invariably deprive the weaker of their share, and render the equal fattening of all the lot impracticable; —conceiving it probable that these and many other disadvantages would be remedied by dividing and feeding the animals in boxes, it was resolved to adapt for this purpose a court which formerly afforded accommodation for twenty ordinary-sized cattle. The court was roofed over, and divided into twenty-seven boxes, each capable of containing two oxen. They were made 11 feet square, leaving ample space for passages from which the cattle are fed, and also abundance of room for a large and excellent house for storing roots. The wood work was constructed from home-grown timber, and put together as economically as was consistent with strength and security. The roof was supported by rough trees, which also served to subdivide the boxes. To these were attached the partition-rails, which were kept open that the cattle might not be excluded from each other's view. Though separated, it was thought better so far to indulge their naturally gregarious habit. The roof was covered with thatch, which has the advantage of every other, being warmer in winter, and cooler and less infested with flies in summer. Above every alternate box three rows of tiles were placed in the roof, the two outside ones being overlapped with the thatch, leaving the centre one open for the purpose of inserting glass tiles, that a subdued light might be obtained, which was all that was required for proper attention to the animals. The bottoms of the boxes were hollowed out 2 feet below the level of the passages, and dwarf-walls built, well groutted with lime for retaining the moisture. Each animal was provided with two wooden troughs, one for turnips, the other for linseed-cakes or corn. The whole expense, exclusive of those wooden troughs, was 35s. per box. Having resolved to test by actual experiment the value of this mode of feeding, the animals chosen for the purpose were a lot of ten small black-polled Forfarshire cattle. They were bought in the Edinburgh market towards the end of September, and kept for a short time on second crop clover, all feeding alike in an open court. At the beginning of October they were carefully divided, with the

assistance of an experienced cattle-agent, and five were put into a well-sheltered court, with plenty of shed room, and the others into the boxes. Though divided as equally as possible, it was thought that those put into the court were rather the best. They then got as many of Skirving's purple-top turnips as they could consume, along with cut straw. It was soon found that those in the boxes eat 112 lb. each per day, while those in the court consumed 134 lb., or 22 lb. more, thus proving that a certain degree of warmth is equivalent to food. They were examined again towards the end of December, when it was thought that those in the courts had improved more than those in the boxes,—something in proportion to the additional food consumed. From the uncommon mildness of the season, those under cover seemed to suffer from being too warm, their hair being constantly wet from perspiration, the thermometer often standing above 50° F., when the temperature fell to about 45°, and they seemed more comfortable, and throve better. At this time the building was more perfectly ventilated by making openings in the outer walls, and covering them with coarse matting, which had the effect of admitting the air more slowly, and without a draught. The cattle in the boxes were, after this, regularly combed—a trifling expense, and apparently well laid out, as it speedily produced a very marked improvement on them. A few days before the beginning of January, their food was changed to Swedish turnips. At the middle of February they were allowed about 2 lb. of corn, which was mixed with their cut straw; this did not, however, make any perceptible difference in the quantity of turnips they eat. They went on improving till the 24th of April, when they were sold and slaughtered.

The following table exhibits the dead-weight of each animal and each lot, in imperial stones:—

CATTLE FED IN BOXES.					CATTLE FED IN COURTS.				
Date.	No.	Stones.	Lb.	Tallow.	Date.	No.	Stones.	Lb.	Tallow.
April 24	1	42	7	281 lb.	April 24	1	48	$10\frac{1}{2}$	240
”	2	46	$3\frac{1}{2}$		”	2	40	$7\frac{1}{2}$	
”	3	45	$8\frac{3}{4}$		”	3	47	$0\frac{1}{17}$	
30	4	47	$0\frac{1}{17}$	196	30	4	48	$10\frac{1}{2}$	186
”	5	51	$3\frac{1}{2}$		”	5	58	$10\frac{1}{2}$	
		232	$8\frac{105}{156}$	477 lb.			243	$11\frac{1}{17}$	426 lb.

This table shows 11 lb. of beef in favour of those cattle fed in the courts, but 51 lb. of tallow in favour of those fed in the boxes —a result, so far as the feeding is concerned, that at first sight seems not very decisive either one way or the other. The saving of food, however, must be kept in view; 22 lb. daily is 154 lb.

a-week, or all but 2 tons for the seven months during which the animals were kept. Calculating the value of turnips at 8s. 3d. per ton, this would be 16s. upon each; but again, the expense of feeding and grooming those in the boxes amounted to 9s. 9d., while the keeping of those in the courts was only 6s. 3d., being a difference of 3s. 6d. upon each beast, which falls to be deducted from the 16s., the value of the turnips saved. When it is considered that the winter of 1850 was one of such unprecedented mildness, it surely cannot be too speculative to infer that the contrast would have been greater had the weather proved as frosty and as ungenial as it usually is. Another thing to be taken into consideration is, that calculations can be made to a nicety of the quantity of litter required. In order to keep the animals comfortable in open courts during wet weather, it is often necessary to keep the threshing-machine almost constantly at work. This often does considerable damage to the grain.

No experiment has yet been made with the manure, but, judging from the strong ammoniacal effluvia which it emits, little doubt can be felt as to its superior efficacy. Besides the proportion of excrement to the straw being greater, it is in all cases perfectly uniform—a point of considerable practical importance, in securing the effect desired by its application. The boxes requiring to be cleared out every six or eight weeks, they were generally found to contain 12 cart-loads of manure each, which might have weighed about 15 cwt. a-piece.

When the spreading of the litter from the outer edges of the boxes was not properly attended to, that portion of it certainly had the disadvantage of being drier than the rest; but it was always in good enough order for ploughing into the ground.

ON THE ACTION OF A PREPARED MANURE ON CLOVER.

By Mr Thomas L. Colbeck, East Denton, Newcastle-upon-Tyne.

[Premium—Ten Sovereigns.]

For some time past I have paid close attention to the clover crop, with the hope of ascertaining some reason for the failure which so often takes place. With this view I have observed the effect of the various manures commonly used, such as horse and cow dung, composts of lime and soil, street sweepings, gypsum, salt, and many others; but having constantly found that not one of these appeared to exert the slightest effect in preventing the disappearance of the clover plant in early spring, I concluded that the failure could not be attributed to the want of the mineral ingredients these various manures were capable of supplying, as they surely contained an ample supply of everything required by the clover crop. This view quite agrees with Dr Anderson's results from the analysis of a soil on which clover failed, compared with one on which a good crop was produced—

chemical analysis failing to detect any difference, to which the loss of the clover crop could be attributed. Perhaps the most singular part of the subject is the good effect produced by growing beans instead of clover. Wherever this is done, the clover seldom or never fails. It might, perhaps, be suggested that the reason of this beneficial action was that the bean crop removed different ingredients from the soil to those removed by the clover plant; but chemical analysis has in this case also failed to detect any characteristic difference, to which the beneficial action of the bean can be attributed. Indeed, the close botanical analogy between these plants renders it highly probable that further chemical investigation will only establish closer similarity.

Having thus failed to suggest any plausible reason for the failure of the clover crop, there could be no hope of being able to establish any plan for avoiding it. I was, consequently, obliged to take a lower aim for the experiments, and endeavour to find a "manure suitable for the clover plant." I quite agree with Dr Anderson's opinion, as expressed in his address to the Society at Glasgow, that "farmyard manure must always be the farmer's mainstay, and that no complete substitute will ever be found for it." But the clover plant has always appeared to me to be *the* crop to which manure will ultimately be applied to a much greater extent than at present, as soon as our farmers are convinced of the propriety of manuring, if not for every crop, at least much more frequently than is usually practised. In the north of England, and in Scotland, where wheat or barley is usually grown after the green crop or bare-fallow, the land is considered to be sufficiently rich to produce a crop without any second application of manure. But clover, being the second crop after manuring, presents a most favourable opportunity for applying any additional manure:—1st, Because the land may be supposed to be somewhat exhausted; and, 2d, Because manure can be applied without injury to the land during the winter and spring after the removal of the grain crop. But even in situations where a sufficient quantity of farmyard manure or compost can be procured, it is in many seasons impossible to get it carted on to the clover, especially in strong clays. In this dilemma, if an artificial manure could be procured that would materially improve the clover crop, a great improvement will be at once gained; because, if we can by any means benefit the clover, it is well known that the oat crop following is always improved, indirectly, but much more surely so, than (in the present state of our knowledge) we have any means of doing by a direct application of artificial manure to the oat crop. In addition to this prospective advantage, I was led to expect success in the experiment from the resemblance between the clover and the turnip, both being broad-leaved plants. As artificial manures had been of such signal advantage to the latter, there was some reason to expect they would be equally beneficial to the former.

Having thus detailed the reasons for the experiment, and the prospect of success, we will now examine it in detail.

In the month of March 1849 I selected two acres, which had been sown with barley in the previous spring with ½ bushel rye-grass, 5 lb. broad clover, 1 lb. of hop, and 1 lb. of white clover, to the acre. On one acre I applied 2 cwt. of the following mixture: bones dissolved in acid, and neutralised by means of alkali, and potash, sulphate of ammonia, and magnesia. On the second acre I applied 2 cwt. of nitrate of potash. The remainder of the field was left untouched. These artificial manures were applied at the time above mentioned, and in April the good effect was already observable. Both plots were of a rich dark-green colour, and the extent to which the special manures had been applied could be distinguished at the distance of a mile. The whole of the experimental field was sold for the purpose of cutting the clover as green food for cattle. Where the special manures were applied, it was fit for cutting ten days before the rest of the field, and three cuttings were taken, the other portions only yielding two. It was found that, though the nitre gave the most vigorous early growth, yet the mixed manure was ready for cutting as early as it was, and in the end gave decidedly the heaviest crop.

The results of this preliminary experiment were not weighed, as it was not my intention to have reported on the subject unless the good effects were visible to the eye; and the extent to which the experiment had been carried was considered too small to warrant any practical conclusion been drawn, even after I had satisfied myself of the success of the trial. The result was, however, so perfectly satisfactory, that I determined to try the experiment again upon a large scale. Having also observed the vigorous early growth produced by the nitrate of soda, a proportion of it (2 cwt. to 1 ton) was mixed with the special manure, hoping by this means to combine the good effects of both; and in other respects the application was the same as the previous year.

In order to guard against every chance of error arising from variation in the soil of the experimental field, the manure was applied in various portions of it, but so as to cover one-half of a fourteen-acre field; this was easily managed, as it was nearly square. The mixture was sown on broadcast in the first week in March 1850. The hay was cut in the first week of July, and each portion being raked separately, the *whole* of the fourteen-acre field was weighed in the beginning of August, every care being taken to insure accuracy. The results were as follows:—

	Tons.	Cwt.		L.	s.	d.
7 Acres manured gave . .	11	12	at 55s.	31	18	0
7 Acres unmanured gave .	8	7	at 55s.	22	19	3
Excess produced by manure,	3	4		£9	0	0
Value of excess of weight, ...				£9	0	0
Cost of application—15 cwt. at 11s. per cwt., . .				8	5	0

I was somewhat disappointed in the results of this second trial, for although the crop had been materially increased, the excess was not nearly so great as that produced by the trial of 1849. This is to be attributed either to, 1st, A difference in the soils; 2d, A difference in the seasons; or, 3d, A difference in the previous cultivation of each field. It so happens that there is a marked difference in all these three points.

1st, A difference in the soils:—

Experiment of 1849.	Experiment of 1850.
The soil is formed from the disintegration of the *upper red sandstone* of the coal series,—does not grow good wheat,—is a turnip and barley soil, but not sufficiently dry for the turnips to be eaten on the ground.	The soil is formed from the clay-slate of the coal series,—grows excellent wheat, and never had a crop of turnips on it. It is a sound, strong wheat soil.

2d, A difference of seasons:—

The season of 1849 was generally favourable to the growth of clover.	The season of 1850 was exceedingly unfavourable. In April there were two or three nights of such extreme frost as to destroy a large proportion of the clover plants, and the entire summer was one of extraordinary dryness.

3d, A difference in the previous cultivation:—

In 1843, Turnips, from farmyard manure.	In 1843, Oats.
1844, Barley.	1844, Bare-fallow.
1845, Pease, instead of clover.	1845, Wheat.
1846, Oats.	1846, Beans, instead of clover.
1847, Turnips from farmyard manure and prepared bones.	1847, Oats.
1848, Barley.	1848, Bare-fallow.
1849, The experimental clover.	1849, Wheat from farmyard manure.
1850, Oats.	1850, The experimental clover.

It will thus be observed that these two fields present the ordinary difference between a strong wheat soil, as usually cultivated with bare-fallows, and a turnip soil. But this is not all,—the experimental clover field of 1849 received in 1847, for the first time, a dressing of superphosphate of lime; and there is now a growing conviction that this manure improves the clover crop when it has been used in growing the turnip crop preceding.

The following is an analysis of each soil:—

1st.—Experimental Field of 1849, by Dr Richardson, of Newcastle-upon-Tyne.

Soluble in Water:—		
Potash,	0.641	
Soda,	0.147	
Lime,	1.733	
Magnesia,	0.166	
Sulphuric acid,	1.444	
Chlorine,	0.711	
Silica,	0.250	
		5.022

Soluble in Acids :—	2.027	
Soda,	0.845	
Lime,	5.441	
Magnesia,	0.760	
Alumina,	14.363	
Peroxide of iron,	20.615	
Silica,	3.168	
Phosphoric acid,	3.216	
		50.429
Insoluble in Acids :—		
Potash,	7.573	
Soda,	3.325	
Lime,	4.137	
Magnesia.	2.032	
Alumina,	58.187	
Peroxide of iron,	8.312	
Silica,	91.438	
Sand,	533.296	
		708.300
Water,		144.740
Organic matter,		91.439
Total,		1000.000

2D.—EXPERIMENTAL FIELD OF 1850, BY DR ANDERSON, EDINBURGH, CHEMIST TO THE HIGHLAND AND AGRICULTURAL SOCIETY.

Soluble in Acids :—		
Peroxide of iron,	3.827	
Alumina,	1.418	
Lime,	0.756	
Magnesia,	0.229	
Potash,	0.133	
Soda,	0.024	
Sulphuric acid,	0.137	
Water	1.581	
Organic matter,	14.706	
		22.811
Insoluble in Acids :—		
Silicic acid,	65.298	
Alumina,	9 774	
Lime,	0.262	
Magnesia,	0.123	
Potash,	0.939	
Soda,	0.581	
		76.977
		99.788
Soluble in Water :—		
Organic matter,	0.157	
Inorganic „	0.365	
	0.522	

Dr Anderson informs me that he has been unable to detect any phosphoric acid in the experimental soil of 1850, whilst that of 1849 contained 3-10ths per cent, or nearly 7 per cent of the soluble matter. I was quite unprepared for such a result, as the field has received every fourth year from 15 to 20 tons of farmyard manure or street-sweepings.

The following are the comparative results of the examination of both soils :—

	Experiment of 1850.	Experiment of 1849.
Soluble in water,	5.29	5.092
Soluble in acid,	60.02	50.429
Insoluble,	770.14	708.300
Water,	15.81	144.740
Organic matter,	147.66	91.439
	998.92	1000.000

The following is a near approximation of the composition of the artificial manure, calculated from the mixture of which it was composed :—

Superphosphate lime,	25
Sulphate of ammonia,	14
Sulphate of magnesia,	25
Sulphate soda,	4
Sulphate of lime,	10
Carbonate of soda,	2
Chloride potassium,	6
Chloride sodium,	3
Fluate lime,	2
Silica and insoluble matter,	2
Water,	6
	99

The above manure was capable of supplying to the soil about 36 lb. of phosphoric acid. According to Boussingault the clover plant is composed of—

Organic matter,	73.92
Ash,	6.08
Water,	21.00
	100.00

The ash, or organic matter, consists of—

Potash,	31.73
Soda,	0.67
Lime,	32.80
Magnesia,	8.40
Chlorides,	7.20
Phosphoric acid,	8.40
Peroxide of iron,	0.40
Sulphuric acid,	3.33
Silicic acid,	7.07
	100.00

According to the above, a clover crop will remove about 23 lb. of phosphoric acid per acre. The artificial manure applied would, therefore, contain enough of this important ingredient, if it was all absorbed, and if not carried off by rains. It must, however, be evident that in the soil the small extra supply (13 lb. over and above the immediate wants of the crop) is much too small a quantity to be depended on. The soil of 1849 contained, in 12 inches deep, not less than 3000 lb. of phosphoric acid. This, I think, sufficiently explains why the last year's experiment was not so suc-

cessful as on the previous occasion; and if the conjecture be correct, the plan to be pursued in future experiments will be to use a much larger quantity of soluble phosphoric acid, or, what would perhaps be still better, to use it ready dissolved in the shape of liquid manure. Future experiments will only decide the extent of influence the season may have had on this year's result, and I would suggest that an artificial manure be tried on a turnip soil as well as on a strong wheat soil.

PROCEEDINGS IN THE LABORATORY.

By Thomas Anderson, M.D., Chemist to the Highland and Agricultural Society.

ANALYSES OF LIMESTONES FROM DIFFERENT PARTS OF SCOTLAND.

In prosecuting the business of the Laboratory, a considerable number of analyses of limestones have been made; and as it is important that the proprietors and tenants throughout the country should have an accurate knowledge of the composition of these rocks in their districts, as a means of estimating their comparative values, I purpose to place these analyses on record.

The difference in composition of different specimens is in many instances very great and very remarkable; and it would have been most desirable to have traced out the cause of these differences, which is, no doubt, to some extent dependent on their geological position. Unfortunately, however, we are, in most instances, precluded from doing so by the deficient state of our information on this point. Many of the limestones which I have analysed are from remote districts, which have not been geologically examined; and even where this has been done, it has either been too deficient in minuteness to define exactly the relations of the individual specimens, or has been confined to a comparatively small district, presenting some prominent points of scientific interest, which have been carefully examined, to the exclusion of those portions which, though of little interest in a purely scientific point of view, may be of much industrial importance. In such inquiries, the absence of a geological survey is particularly felt, as at present an analysis serves only to determine the value of the quarry from which the specimen was taken; while an accurate geological examination, by tracing the strata, may determine their identity over a large district, and make one analysis serve for all. At present this cannot be done; but by placing the analyses made in the Laboratory on record, they will, in the mean time, form a contribution to our knowledge of these rocks in different districts; and should a geological examination be at a future time carried out, they may acquire an additional importance.

In conducting these analyses attention has, in almost every instance, been directed not merely to the percentage of carbonate of lime, but also to that of the constituents, which are present in small quantity, and which are likely to have any influence in an agricultural point of view. Phosphoric acid and sulphuric acid have been carefully sought for, under the impression that they might be more frequently present than has generally been supposed; and the results show that that impression has been well-founded, and that, in many instances, both are to be found. It is true, the quantity is small, and at first sight seems inconsiderable; but it ceases to be so when we consider the large quantity of lime applied. One-tenth of a per cent of phosphate of lime in a limestone is equal, in 20 tons of the stone, to 45 lb., or to a quantity as large as would be removed from the soil by several crops, or supplied in 2 cwt. of Peruvian guano; and if we bear in mind that it is *lime* which is applied, and not limestone, and that the latter may be reckoned at about double the weight of the lime obtained from it, we shall understand that the application to the soil of 20 tons of lime, obtained from limestone containing 1–10th per cent of phosphate of lime, supplies about 90 lb. of that substance, which is equal to the quantity contained in 4 cwt. of Peruvian guano. Similar remarks apply to sulphuric acid, of which appreciable amounts have occasionally been found; although, from the low price of gypsum, its importance is much less than that of the phosphate. In these analyses I have endeavoured to trace some connection between the presence of phosphoric acid and that of animal remains in the limestones, but without arriving at any satisfactory results. In some instances it has been found in limestones belonging obviously to a very early geological period, and in which organic remains are either extremely rare or altogether deficient; in others, of later periods, none has been found—and this was remarkably the case in a specimen containing a fossil fish, in which repeated and careful examination failed to detect its presence. The proportion of organic matters contained in the limestones has generally, though not always, been determined. Their quantity is generally extremely trifling, and they have been determined less from their importance than from a desire to make the analyses complete.

The analyses are of some interest, as they show that limestones of the magnesian class are more widely distributed through Scotland than has been generally supposed. I am unable, in most instances, to connect the occurrence of magnesia with any particular geological period; but it appears to be chiefly found in the earlier formations. At the same time, limestones free from that substance are often found at no great distance from those which contain it abundantly. In every instance I have preferred the analysis of the limestone to that of the lime obtained from it, as

that of the latter is an exceedingly uncertain matter;—partly because different parts of the stone may be burned with different degrees of completeness, so that a very unfair estimate of the whole may be made from the analysis of one portion; and partly because the quicklime is so liable to undergo change by absorption of water and carbonic acid from the air, that it is difficult to obtain it exactly in the state in which it leaves the kiln.

Limestones from Argyleshire.—Four limestones from different parts of the property of Mr Malcolm of Poltalloch have been analysed, and their composition found to be as follows:—

	Island of Macasken.	Mullau.	Culnuick.	Meall.
Siliceous matter,	21.57	4.83	21.30	46.90
Peroxide of iron and alumina,	0.95	1.35	1.50	1.60
Carbonate of lime,	75.82	90.73	76.04	49.69
Carbonate of magnesia,	1.64	2.62	1.09	1.34
Organic matter,	0.22	0.37	0.43	traces.
	100.20	99.90	100.26	99.53

In these analyses we have the occurrence of siliceous matter to a larger extent than is usually found. One only (that from Mullau) can be considered as a limestone of first-rate quality; the others are all inferior, and that from Meall must be considered as being of scarcely any value. The presence of siliceous matter in considerable quantity is always objectionable, because, in the process of burning, the lime, when liberated from the carbonic acid, enters into union with the silica, and forms a compound called silicate of lime, in which state we have reason to believe the value of lime for agricultural purposes is much smaller than it is in the uncombined state. In none of these were either phosphoric or sulphuric acids present.

Limestones from Sutherlandshire.—I am not acquainted with any analysis of limestones from Sutherlandshire, so that some interest will attach to the following series of analyses of no less than fifteen specimens of limestone from the properties of his Grace the Duke of Sutherland, which are an instructive example of the variety in the composition of these rocks.

The following are the localities from which the specimens were taken:—

No. 1. Shiness, top.
No. 2. ... middle.
No. 3. ... bottom.
No. 4. Knockdu Elpine, No. I. (bluish-grey.)
No. 5. .. No. II. (greenish-grey, with a marble-like texture.)
No. 6. Duirness.
No. 7. Eribole, from the sea-side.
No. 8. ... powdered limestone.
No. 9. Achmore, No. I. (pale bluish-grey.)
No. 10. ... No. II. (darker, and more crystalline.)
No. 11. Stronchrubie, No. I. (white, and crystalline.)
No. 12. ... No. II. (dark-grey.)

No. 13. Kirktown.
No. 14. Ledbeg, No. I. (nearly white, and very crystalline.)
No. 15. ... No. II. (grey and earthy.)

	No. 1.	No. 2.	No. 3.
Silica,	7.42	2.52	4.77
Peroxide of iron and alumina,	0.76	0.28	0.46
Carbonate of lime,	84.11	93.70	89.95
Carbonate of magnesia,	7.45	3.49	4.93
	99.74	99.99	100.11

	No. 4.	No. 5.
Silica,	23.07	1.56
Peroxide of iron and alumina,	1.92	1.08
Carbonate of lime,	41.58	53.77
Carbonate of magnesia,	33.47	41.01
Water,	...	2.02
	100.04	99.44

	No. 6.	No. 7.	No. 8.
Silica,	2.77	6.41	8.06
Peroxide of iron and alumina,	0.28	0.90	0.76
Phosphate of lime,	0.27	traces	0.17
Carbonate of lime,	90.01	51.04	49.50
Carbonate of magnesia,	6.50	41.36	40.85
Organic matter,	0.04	0.23	0.17
	99.87	99.94	99.51

	No. 9.	No. 10.	No. 11.
Silica,	2.68	3.00	1.77
Peroxide of iron and alumina,	0.35	0.22	1.33
Carbonate of lime,	53.51	54.88	45.79
Carbonate of magnesia,	43.20	41.85	48.72
Water,	...	...	2.01
	99.74	99.95	99.62

	No. 12.	No. 13.
Silica,	7.51	6.00
Peroxide of iron and alumina,	0.48	1.57
Phosphate of lime,	0.61	...
Carbonate of lime	48.00	50.21
Carbonate of magnesia,	42.01	41.22
Water,	0.93	0.69
	99.54	99.69

	No. 15.
Silica,	6.42
Peroxide of iron and alumina,	0.74
Carbonate of lime,	51.33
Carbonate of magnesia,	41.08
	99.57

The limestone (No. 14) from Ledbeg presented some very remarkable peculiarities, and belonged to a class of limestones regarding which we have at present almost no information, although they present much scientific interest. Several analyses were made, in which, as had been done in the others, the lime was calculated as being entirely in combination with carbonic acid, and the results were as follows:—

	No. 14. I.	II.	III.
Siliceous matter,	2.91	2.93	2.82
Peroxide of iron and alumina,	0.14	0.22	0.20
Carbonate of lime,	90.67	90.52	90.61
Carbonate of magnesia,	8.20	8.19	8.22
	101.92	101.86	101.85

In all these analyses (which agree as closely as possible) we observe that the sum of the constituents amounts to nearly 102 parts in place of 100, as it ought to be. Another analysis was therefore made, in which the exact amount of carbonic acid was determined directly, and not inferred from the quantities of lime and magnesia, and the result obtained was as follows:—

Siliceous matter,	2.82
Peroxide of iron and alumina,	0.20
Lime,	50.74
Magnesia,	3.52
Carbonic acid,	42.62
	99.92

In this analysis the fact is determined that the amount of carbonic acid is not sufficient to combine with the whole of the lime and magnesia, and there seemed little doubt what part these bases must exist in a state of combination with silica. Another analysis was therefore made, in which the limestone was dissolved in acetic acid, which I expected would not be sufficiently powerful to decompose the silicate of lime or magnesia, if any such existed. The results were—

Siliceous residue,	4.34
Peroxide of iron and alumina,	0.20
Carbonate of lime,	91.32
Carbonate of magnesia,	4.74
	100.60

We here observe a quantity of carbonate of magnesia much smaller than is found in the previous analyses, while the quantity of siliceous matter has undergone a corresponding increase. It is obvious, therefore, that a part of the magnesia exists as silicate, which has not been decomposed by the weak acetic acid which has been employed in the analysis. I infer from these results that this must be a metamorphic limestone, by which is meant one which has been altered by the action of heat after it has been deposited. The change which it has undergone illustrates, in an instructive manner, that which occurs when a limestone containing much siliceous matter is burned, a part of the lime or magnesia combining with that substance to form the silicate of lime, to which I have already referred.

An examination of the analyses of these fifteen limestones

shows that out of the whole there are only five which could be recommended for agricultural purposes. In all the others, magnesia is present in too large quantities to admit of their safe application; for it is well established by practice that limes containing much magnesia must be applied in small quantities, and with much caution, and that even then their effects are sometimes injurious, and almost always inferior to those of the purer limes. There is no doubt that magnesian limes may sometimes be beneficial, especially upon a soil in which that element is deficient; such soils, however, are rare, and it is far better to employ a large quantity of some of the pure limes, most of which supply, in the small percentage of magnesia which they contain, a sufficient quantity for the use of the plants. It is interesting to observe the presence of phosphate of lime to a very considerable extent in some of these limestones. In No. 6, which is an excellent limestone, *a ton* contains about 6 lb. of phosphate of lime; and 20 tons—a quantity which has often been applied to an acre—would supply 120 lb. of phosphate, or as much nearly as 6 cwt. of guano.

Limestones from Mid-Lothian.—The following are particularly interesting as specimens of limestones, of which the value is decidedly increased by the presence of phosphoric and sulphuric acids. They are different portions of the same bed, on the property of the Earl of Morton.

	I.	II.	III.
Silica,	2.00	2.19	6.21
Peroxide of iron and alumina,	0.45	0.13	0.25
Carbonate of lime,	93.61	89.83	89.21
Carbonate of magnesia,	1.62	4.77	1.44
Phosphate of lime,	0.56	0.39	0.46
Sulphate of lime,	0.92	0.82	1.24
Organic matter,	0.20	1.25	0 15
Water,	0.59	0.74	0.70
	99.95	100.12	99.66

Limestone from the neighbourhood of Nairn.—Some time since a specimen of limestone, containing a fossil fish, was sent to the Laboratory by Mr Brodie of Lethen. It was a portion of a deposit in which organic remains are found abundantly, and which is much esteemed in the neighbourhood for its agricultural value. I naturally anticipated that this might be due to the presence of phosphate of lime; but, on careful analysis, none was found, and the composition of the limestone was as follows—

Siliceous matter,	14.91
Carbonate of lime,	81.49
Carbonate of magnesia,	1.33
Peroxide of iron and alumina,	1.65
	99.38

As no phosphoric acid was found, it struck me that it might be

interesting to make an analysis of the insoluble siliceous residue. This was accordingly done with the following results:—

Silica,	75 25
Alumina,	15.40
Peroxide of iron,	traces
Lime,	0.51
Magnesia,	1.48
Potash,	1.92
Soda,	0.81
	99.87

Here, in the presence of alkalies, in small amount, we have a new source of valuable matters, which would become available on burning, by which the potash and soda would be liberated from their insoluble combination. It is true the quantity would not be large, even with a very considerable application, but it might be of importance in a district in which the alkalies are deficient.

Limestones from Fifeshire.—Some time since comparative analyses were made of the limestones of Grange and Chapel quarries near Burntisland, which are interesting, as both contain a certain quantity of iron pyrites or sulphuret of iron, the sulphur of which, during the burning of the lime, will be converted into sulphuric acid, and add considerably to the quantity of that substance which is present in the unburnt state.

	Grange.	Chapel.
Siliceous matter,	12.43	8.14
Sulphurate of iron,	2.70	1.01
Carbonate of lime,	81.70	88 92
Carbonate of magnesia,	1.56	1.25
Sulphate of lime,	0.08	0.12
Phosphate of lime,	...	0.43
Organic matter,	1.36	...
	99.84	99.87

Here, of course, we have a decided difference in the value of the two limestones, and that not only in the proportion of lime which they contain, but also in that of those minor constituents, on the importance of which I have already insisted.

The following is the analysis of a limestone proposed to be employed, not agriculturally, but in the manufacture of iron. It is from the iron district of Fifeshire, and is interesting from the considerable quantity of iron it contains, as well as from the presence of alkalies.

Silica,	9.58
Protoxide of iron,	8 26
Alumina,	0 85
Lime,	26.65
Magnesia,	11.46
Potash,	0.31
Soda,	0.65
Sulphur,	0 23
Phosphoric acid,	0.09

Carbonic acid,	38.57
Water,	1.71
Organic matter and loss,	1.64
	100.00

In this instance the iron obtained was partly in the state of protoxide, and in combination with carbonic acid. A small quantity also existed in combination with sulphur.

Limestones from Dumfriesshire.—The supply of lime in the county of Dumfries has long been limited, but of late years more attention has been called to it, and some beds found; and it is not improbable that, if the district was geologically examined, a larger supply might be found. The only limekilns of any extent are those on the Closeburn estates. The limestone used there has been analysed along with another from Barjarg, which, however, belongs to the magnesian class. The results of these analyses are as follows:—

	Closeburn.	Barjarg.
Siliceous matter,	9.74	2.31
Peroxide of iron and alumina,	1.18	2.00
Carbonate of lime,	85.18	58.81
Carbonate of magnesia,	3.79	36.41
Sulphate of lime,	0.32	0.10
	100.21	99.63

I believe the Barjarg limestone belongs to the new red sandstone formation, in which magnesia is frequently found. The exact position of the Closeburn rock is accurately described in the Society Transactions for October 1844. Neither of these limestones contained phosphate of lime, although it was carefully sought for.

These analyses may serve to present a general idea of the great differences in the limestones of different parts of Scotland, and to show the farmer that some discretion must be exercised in selecting that which he applies to his land. The conditions of the application of lime, and the general precautions to be attended to, however, are now so well known, that it is unnecessary for me to enter into any details on the subject. I shall simply refer to the use of crushed or powdered limestone, which seems to me deserving of attention where fuel is expensive. One of the analyses given above of a Sutherland limestone is that of a specimen which had been reduced to coarse powder by water-power, and which had been used with success. I am strongly impressed with the opinion that limestone, when crushed, would be found to have a beneficial effect as a top-dressing on old pastures in many parts of the Highlands, where fuel is too expensive to admit of its being burned. I know that it has been tried, but no account of the results has been published, to my knowledge; and it would be conferring a valuable boon on the agriculture of these districts, if those who have tried it would publish their experience.

On the COMPARATIVE ADVANTAGES of FIXED and PORTABLE STEAM-POWER for the PURPOSES of a FARM.

By Robert Ritchie, Esq., Assoc. Inst. C. E., F.R.S.S.A., Edinburgh.

[Premium—The Gold Medal.]

The importance now deemed paramount in the application of steam as a motive-power, makes its proper adaptation at the farmstead of great moment to the agriculturist.

The various descriptions of steam-engines which are used on farms, seem to manifest an uncertainty in the best form of steam-engine to drive barn machinery. From this cause, an inquiry into the comparative advantages of fixed and portable steam-engines applicable to the purposes of a farm, is a subject which must command the interest of the agriculturist. The writer of this paper has been induced to make such an inquiry, and will be glad to find that his observations have proved useful.

Preliminary to the consideration of the subject, it will be proper to take into view what are the essential requisites to obtain the greatest advantages from a prime mover of barn machinery. The solution of this question will go far to determine the point upon which agriculturists desiderate information. The writer holds that the points most important that the moving force at the barn should possess are—

1st, Stability and durability, without loss of power and increase of friction.
2d, Simplicity of management.
3d, Non-liability to derangement of the parts.
4th, Safety—as freedom from all danger of steam explosion.
5th, Thorough economy of fuel, and no danger of fire from the chimney.

The first is perhaps the most essential quality which a steam-engine, to drive a thrashing machine, can possess. From the inequality of the work the mill has to perform, according to the grain passed through the mill, and the state of the straw itself, whether dry or damp, long or short, it becomes of essential importance for the durability of the engine that it be firmly fixed, and not be liable to vibration, otherwise the framework of the engine and machine will become shaken; and the bushes in which the shafts turn, being thereby unequally worn, will produce irregularity of motion, and injure the teeth of the wheel and connecting gearing. Hence stability—at all times essential in the moving force for machinery—must be much more requisite where the duty to be performed varies so much as it does in connection with the thrashing-machine, where sometimes is demanded the power requisite to work the thrashing-machine itself at a quick speed—sometimes the

increased power which elevators require—sometimes the super-added power which is requisite to drive corn and bean bruisers, straw-cutters, or other machines—and sometimes the engine is required to work them all together.

Such an engine must have strength of parts and material to prove durable, otherwise it would not last an ordinary lease of nineteen years, which it must be the farmer's interest that it do, if he be the erector; and it surely requires little reflection to determine that, when the engine is incorporated with the building, there is much more probability of attaining these objects than when an engine is made use of, of a slight portable description, which, from the very principle of its operation—its portability—is constructed as light as possible; and it is hardly possible for lightness to be combined with great substantiality. The writer need hardly notice the fact, that if an engine possesses—suppose of the portable description—merely the power to thrash, without the capability of readily working subordinate machines, such an engine, applied to a modern farmsteading on the best principle, must be so obviously a defective machine, that the application of it by an experienced farmer would be viewed as a positive grievance, and what he would not possibly submit to but where it was unavoidable. The point being, therefore, so palpably obvious, that stability, and consequent durability, must be with greatest certainty attained from an engine attached to and incorporated with the building, the great advantage on this important head must be manifest in the case of a farmer of a farm of any extent, and with properly-constructed farm-buildings, is clearly and indisputably his interest to have a fixed steam-power and thrashing-machine.

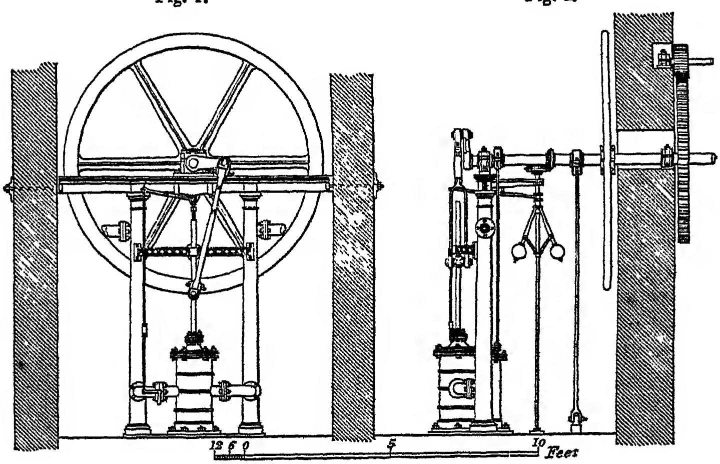
This point being decidedly established—which must be admitted by every person conversant with the use of machinery—the writer will now proceed to consider the other particulars which a farm engine should possess; and he trusts he will convince every reasonable and unprejudiced mind, that in all these it will be found that the balance of advantage appertains to the fixed engine. He may include under one head the consideration of these particulars—namely, simplicity of management—non-liability to derangement—freedom from danger of steam explosion—economy of fuel—and freedom from risk of fire from the chimney.

For the just consideration of these points, it is necessary to take into view the characteristic distinction between a fixed steam-engine and boiler and a portable engine and boiler. The fixed steam-engines, as is well known, which are used at farmsteads, are of various forms; but in general, on account of convenience, for supply of water, and to lessen the cost, most commonly high-pressure or non-condensing engines are used. Sometimes these non-condensing engines are what is termed beam-engines, the

distinguishing feature of which consists in the axis or working centres of the beam being supported upon a framing or entablature resting upon six cast-iron pillars, which are bolted to a sole-plate secured to a stone seat; but some engines are made with the beam supported upon one strong centre pillar, and sometimes the pillar which supports the beam is made vibratory. But of the engines erected on farms in the earlier times, many were upon the condensing principle; subsequently the condensing apparatus was dispensed with, and the same passage for the steam which led to the condenser, conveyed it, at every half-stroke of the piston, at once into the atmosphere.

The engine now most commonly used in the south of Scotland and north of England, are overhead crank engines, figs. 1, 2, 3, 4. All these engines are firmly seated, and the crank-shaft, passing through the barn-wall, is attached by direct action to the spur-wheel of the thrashing-machine, and sometimes to the drum-shaft. Sometimes intermediate wheels bring up or down the speed, but all intermediate gearing is, if possible, avoided between the engine and the mill. It is hardly necessary to particularise here the advantages or disadvantages of the various forms of fixed engines which have been used; but as the writer considers stability and simplicity should be a guiding point in the choice of the engine, he can point to no better form of one to attain these objects, than the common crank steam-engine, figs. 1, 2, with two hollow

Fig. 1. Fig. 2.



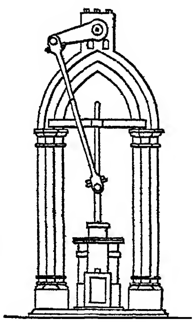
FRONT VIEW. SIDE VIEW.

columns which serve as steam-pipes, surmounted by an entablature, which rests at each end on walls prepared for the purpose, to

which it is bolted. The two columns are firmly secured to an iron sole-plate, and the latter is bolted to the stone blocks upon which it rests. The entablature supports the outer bearing of the crank-shaft, while its opposite end rests in a pillow-block resting on the wall which separates the engine-house from the barn. The walls which support the entablature, upon which the crank-shaft and the fly-wheel of the engine rest, are placed at such a distance apart—about 9 feet—as will give sufficient space for the action of the fly-wheel. The engine is thus firmly and securely attached to the building, and no danger can arise of any one coming in contact with the fly-wheel. The durability, utility, and extreme simplicity of this form of engine has been so completely established, that it is unnecessary to enter further upon it; but it may be satisfactory to refer, as examples, to various steam-engines on this plan erected on farms in the Lothians. Engines of the same construction are made with the steam-pipes unconnected with the pillars.

Another form of this engine, which has been much used, consists of a solid iron frame or pilaster, fig. 4, which rests upon a strong iron sole-plate. This engine is sometimes made with two pillars, fig. 3, of a Gothic form, and sometimes with a Roman doric pilaster. In most of these engines the shaft conveys the power almost invariably to the spur-wheel of the thrashing-machine; intermediate wheels are, however, occasionally unavoidably used, and the result may, according to circumstances, be a loss of from one and a half to two horse power. In other overhead crank-engines, the crank-shaft is supported on four pillars instead of two.

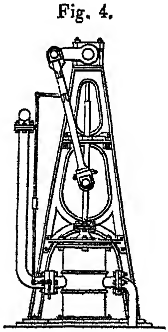
Fig. 3.



ELEVATION.

The efforts of every engine-maker and mill-wright engaged in the erection of farm engines is to attach the power of the engine as directly as possible to the mill, without any intermediate gearing to occasion friction or loss of power.

Fig. 4.



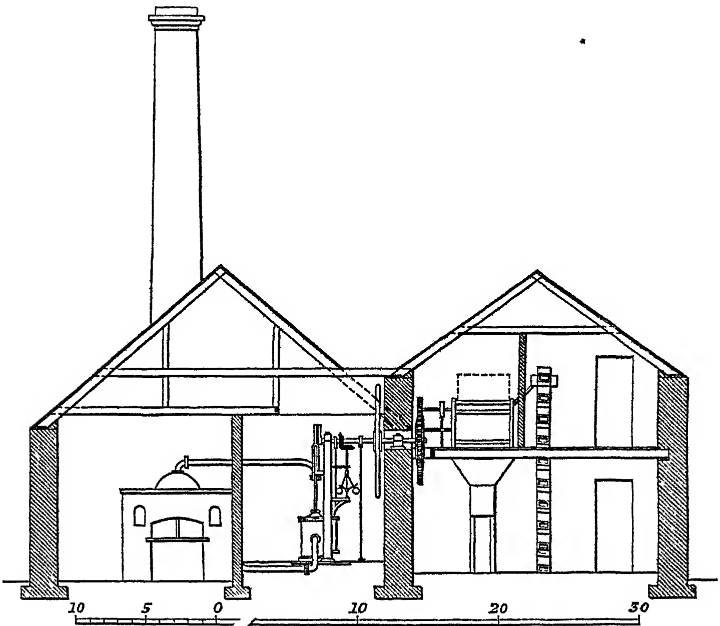
PROFILE.

In another form of overhead crank-engine, the fly-wheel is formed like a spur-wheel, with teeth on the exterior of the rim, which serves at the same time to regulate the velocity of the engine, and to transmit the power by another wheel directly to the machine to be set in motion.

In all the varied forms of engines, when applied to a thrashing-machine, the power of instantly disengaging the engine from the barn machinery is indispensably requisite. The

want of such power of disengaging the prime mover from the acting agent, has led, and may lead, to many accidents; and no steam-power applied to barn machinery can be deemed safe or perfect unless proper arrangements exist for carrying out this

Fig. 5.



object. Where belts form the connecting medium for transferring power by means of smooth drums, they are very easily thrown in or out of gear, or shifted by the adaptation of pulleys. When toothed wheels form the connecting gearing, the means of disengaging the prime mover may be easily accomplished.

In all the non-condensing engines to which the writer has alluded, the boiler is simply an oblong cylindrical one, with hemispherical ends of strong malleable-iron plate of the simplest construction. In some few instances the boilers are square at the ends, having a flue or flues passing through them; but the circumstance that so many of the boilers for these engines are made as first noticed, shows they answer the purpose, are easily managed, and not liable to go wrong. Although it is undoubtedly the case, that the steam will be more quickly raised with the flued or tubular boilers, still the disadvantages of complication, and difficulty of repair, and increased expense, operate against their being generally used.

It may be observed, that farmers, engineers, and millwrights,

seem to have concurred and settled on the adoption, now almost invariable, of a fixed engine and boiler possessing simplicity of parts, and usually having the crank-shaft of the engine directly attached or secured to the spur-wheel of the thrashing-machine, (fig. 5,) all belts or intermediate gearing being as much as possible avoided. Thus has experience led to the development of an established principle and axiom, that the fewer the parts the more simple the machine; and the more direct the action of the prime mover can be applied, the less the loss of power from friction, and the more easily will the machinery be understood, and the less consequent liability to get out of working order. It cannot fail to be perceived that these engines possess the very essential requisites that a farm-engine should possess, namely, simplicity of management and non-liability to derangement; and from the simple and strong construction of the boiler, and easy mode of cleaning and repairing it, it is not liable to the danger of explosion, and insures, with ordinary management, sufficient economy in fuel. With a properly elevated brick chimney, as is usually applied to fixed engines, and which should be very neatly constructed, there can be no danger whatever of fire from the sparks from it.

By adopting the plan of enclosing the boiler with non-conducting materials, as has been done with the Cornish boilers, in which a strict regard is paid to prevent any waste of steam by conduction, a great saving of fuel would be effected in farm engines. It has been ascertained that the average expenditure of fuel for the Cornish engines has been reduced from 10 to 14 lb. per horse-power per hour: the quantity usually consumed by a common engine from 5 to 7 lb. per horse-power per hour. The chief peculiarity of the Cornish boilers consists in the covering of the boiler and steam-pipes to prevent condensation.

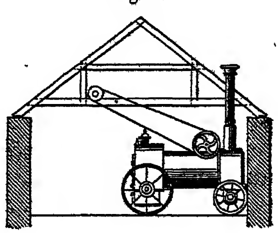
Having now shortly noticed the application of the fixed engine, the writer will point out the characteristics of the portable engine for the farm. The engine and boiler are on a carriage with wheels; sometimes the thrashing-machine is placed on a separate carriage, and sometimes both engine and machine are placed on the same carriage: the whole being portable, is capable of being drawn by several horses. What object can be obtained by locomotion to a farmer of ordinary prudent habits of management, in the present state of husbandry, the writer is at a loss to comprehend. If thrashing stacks in the field is the manner the farmer conducts his business, no doubt removing the engine from field to field may be a lazy expedient, and in some cases may prove convenient; and where a portable farm-railway is used, it will be easily transported. No doubt, in England, thrashing in the field is extensively adopted, and is more common than the more economical plan of thrashing at the homestead, and having the thrashing-machine established in the barn. In some parts of England,

the occupier of a large farm prefers having several barns at different parts of a farm to having them all placed in one central position near his dwelling-house, on account of the saving of cartage; and hence, for such an arrangement, portable machines may be valued. But is the mere thrashing of a rick the whole summit of a farmer's ambition?—and is he not yet alive to the great advantages arising from the capabilities of the fixed farm-engine being applied to a great variety of useful purposes, which the experience of every year is immensely increasing?

It seems unnecessary to notice the inconvenience of thrashing in the open air in a climate such as this, and the injury the grain must sustain. It is a well-ascertained fact that the ancients, even in the better climate of Italy, could not dispense with a covering for their thrashing-floors in the open field, and sometimes a covered place was used for the corn contiguous to the thrashing-floor. It was reserved, it seems, for the modern Britons to exhibit the advantages of steam-engines and thrashing-machines that will thrash grain as of old in the open fields, and to dispense with the storing of stacks in the rick-yard, and with a barn and granary altogether! But what a waste of labour, as well as loss of grain, is incurred by this plan. The portable engine, after all, is not so very portable—its weight not being so very inconsiderable as to make it easily moved and transported. It can be moved without a railway on a hard road; but upon a soft farm-road, and still softer field, its removal is an operation of no inconsiderable magnitude and difficulty, as it takes even several horses to move it upon a common road. No doubt there are several forms of portable engines as well as of fixed engines. Some of the more prominent of the locomotive description may be noticed, and they may be familiar to the readers of agricultural papers. Were the writer addressing an agricultural society of England instead of Scotland, he would consider it necessary to go into a detail of the various kinds of these portable engines. It may be sufficient here to allude to those which have more recently been brought forward.

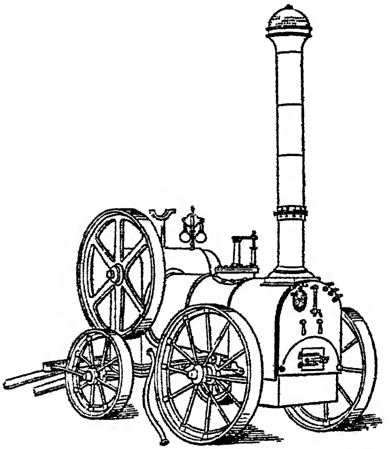
Engines of the annexed form, (figs. 6 and 7,) some of which have been erected in Scotland, may be seen at different places and judged of; and from these sketches of portable engines, it may be perceived that they bear considerable similarity to each other, and in principle they are the same. Such engines do not from their difference of form indicate originality, as they are all constructed entirely on the plan of a locomotive engine with tubular boilers, fire-box, smoke-box, and blow-off pipe, (conveying the waste steam

Fig. 6.



from the cylinder,) governor, &c.; but instead of having the cylinder below, or on the sides of the boiler, as in railway engines, the cylinders are placed on the top or sides of, or within, the boiler. Most of the portable engines may be, then, described as simply railway engines and boilers, and do not present any features of novelty. It is believed that large prizes have been awarded for these engines at agricultural shows. Such engines, or boilers with an iron funnel or chimney, are constructed upon a frame with wheels, the weight being from 50 to 75 cwt. and upwards, according to the horse-power. It requires three horses to draw a nine-horse-power engine of this kind. In these engines (figs. 6 and 7) the fly-wheel is made to act as a pulley or drum for a band or belt connecting the power with the machinery to be driven, as the thrashing-machine. This plan of communicating the power has been long in use for stationary steam-engines, and for subordinate machines. It is somewhat remarkable that it is described in a communication to the Highland and Agricultural Society, in their Transactions for 1832, on the application of steam-power to farmsteads. It is there observed, "that, by means of smooth iron drums, to which a broad strap adheres by its friction, the power is communicated from the prime mover to the acting agent, and the drum may be compared to an infinitesimal number of teeth produced by friction, which toothed wheels are a definite number of teeth acting on each other. Amongst other advantages of the belt is pointed out that, should foreign substances get into the mill, the belt is at once thrown off, and no injury is done; whereas with wheel and pinions, when a similar accident occurs, a wheel or shaft may be broken." It is thus perceived that, long before portable engines were in use on farms, the plan adopted of communicating the power was practised with fixed engines on farms. But notwithstanding the high encomiums of the method referred to by the writer, the practice of using belts for connecting the prime mover with the acting agent has not been much adopted. This method has been found to be attended with

Fig. 7.



disadvantages, from which direct application is free. The plan in general use appears to be, that where high velocities are required, the belt and drum are preferred in machinery; but, in connecting a prime mover with the acting agent at a moderate speed, toothed wheels in the various ways practised are preferred: there is no risk with wheels, as with bands of the latter, slipping off and proving troublesome, because toothed wheels admit of simple adjustment, and are as easily thrown in and out of gear as bands.

There are several descriptions of portable engines which have been used in England anterior to those which are now more prominently brought under public notice. One of these engines was patented in 1838, and recommended for its portability. Indeed, light steam-engines and boilers, and thrashing-machines, placed on a wheeled platform and driven from place to place by horses, have been used in parts of England for some years back. The improvements, so called, recently made upon these portable engines, apply more to the mode of construction than the principle of action. The use of these engines in England is now become very common.

Portable engines of this kind are very useful for small farms, and dispense with the laborious and injurious processes of horse-power and the flail. But what comparison can be drawn between a rude and imperfect mode of using steam-power and thrashing-machines carried about on carriages from farm to farm, and the palpable advantageous one derived from a stationary thrashing-machine, driven by a fixed, steady, and cheap motive-power, at all times under the command of the farmer? The wonder is, how the farmer of land to any extent can do without such a fixed power, the want of which must place him under many disadvantages, for which no temporary substitute can compensate. If the reason of preferring a portable engine is, that on large farms different barns situate at distances are useful, be a correct one, then it can apply to but very few farms, as the preponderance of farms are small. Few farmers will be found in Scotland urging such reasons for using a portable engine and mill, even with the disadvantage of a little more carriage, when they have once tried and determined the advantages derived from a well-arranged farmstead with a stationary power, and their stacks placed in a good barnyard, secured from the risk of pilfering, or the danger of incendiarism. Besides contrasting the portable steam-engine and portable thrashing-machine with the stationary steam-engine and stationary thrashing-machine, there is another aspect in which this subject must be viewed, and perhaps the most common which may occur—that is, a comparison between a portable engine applied to a fixed mill, (as has sometimes been done,) with a fixed steam-engine to the fixed thrashing-machine. As respects the *first* view, the preceding statement of the preference given to the portable engine and

portable mill, as used in England—perhaps as regards large farms —is the strongest argument which can be used in its behalf. As respects very small farms, this plan may be useful where no properly constructed farm-buildings exist, or where, from the smallness of the farm, it may not be worth while to erect farm-buildings. Beyond these two cases, hardly any possible advantage can arise; and in the application of the portable engine to the portable mill, there is always the disadvantage which the portable thrashing-machine incurs, that it does the work imperfectly: it may thrash, but it does not clean the grain at the same operation. In almost all the portable thrashing-machines, the object seems more to perform the work quickly than perfectly; hence arise the loss of grain and the imperfection of the shaking process. The plan of using portable thrashing-machines in the fields is, at best, but a crude and slovenly manner of performing the operation of thrashing, and is undeserving of imitation. Some millwrights, indeed, chiefly in the west of Scotland, have recently attempted to introduce portable thrashing-machines on a large scale, with elevators. Their bulky construction does not admit of their being moved from place to place, and hence they are more adapted for the barn than the field; and to call them portable is a misnomer. These machines are made with cast-iron framing, and are sometimes termed the peg-drum beater, and made with the common drum-beater, 2½ inches broad, armed with a double row of iron pegs, about 2 inches long, the drum working downwards, as in Atkinson's patent peg-machine. There is usually one shaker to these machines. The fanners and riddles are placed on the top, and the grain is lifted to them by elevators, and is received, when dressed, at the bottom. The utility of a machine of this construction, however compact, is hypothetical. It must be chiefly advantageous for small farms, or in cases where the machine cannot be conveniently incorporated with the farm-buildings. The expense of a machine of this kind varies from £56 to £65; and for small farms, from £25 to £35, for two-horse power. With respect to the advantages or disadvantages of the common and peg-drum beaters, the subject has been already discussed in the Society's Transactions for October 1849, and it is unnecessary to enter upon it here. The writer there gives the preference to the peg-beater machine over the common beater and the patent peg-drum.

The *second* aspect in which the subject may be viewed, is the application of a portable engine to a fixed thrashing-machine. On this head the matter may be considered in reference to first cost and expense of maintenance. The writer of this paper has had opportunities of testing the comparative advantages of the two modes of steam-power applied to stationary thrashing-machines, and he has no hesitation in giving a preference to the fixed steam-

power. As regards the first cost, there does not appear to be any advantage in favour of the portable engine. The following may be given from published prices of portable engines during the last year upon the locomotive principle, some of which have been erected in Scotland to drive the common fixed Scotch thrashing-machine at the barn, and figs. 6 and 7 placed in the horse-path :—

The price of what is termed a 5-horse power, single cylinder, portable engine, and tubular-lined boiler, with iron funnel, upon four wheels, erected at the farm, exclusive of connecting or mason work, weight 50 cwt., £174—said to thrash about 35 quarters of wheat per day of ten hours, consuming about 3 cwt. of coal and 270 gallons of water.

A 7-horse ditto, ditto, weight 60 cwt., £217—said to thrash about 60 quarters of wheat in ten hours, with about 7 cwt. of coal and 450 gallons of water.

A 9-horse ditto, ditto, weight 75 cwt., £248—said to thrash 85 quarters of wheat in ten hours, with about 9 cwt. of coal and 800 gallons of water.

In neither of these engines do these prices include a well, or the providing water, or connecting and mason-work.

The charge for prize portable engines of a somewhat similar construction, by another maker, is thus stated :—

For a 4-horse portable steam-engine, with tubular boiler, upon four wheels, double shafts, &c., £240. For a 6-horse, £255.

The portable thrashing-machines are an extra charge :—

The price of a 4-horse portable thrashing-machine, by one maker, is given from £36 to £45. If this be combined with the engine first mentioned, of £174, it would make the total cost about £219. Or, if added to the price of engine by another

maker, ...	£240 + £45 = £295
Machine, if fitted with a shaker to separate the corn from the straw, ...	21
	£316

These costs may be given, by way of comparison, with fixed steam-engines.

The price of a fixed crank overhead engine, as erected in the Lothians, made by respectable makers, upon the most improved construction, is as follows :—

Engine of 4-horse power, as shown in figs. 3., with cylindrical boiler, 9-inch cylinder, 2 feet stroke, boiler 11½ feet by 3 feet 8 inches diameter, 5-16ths thick, attached to a mill, and placed in a horse-walk, as shown in fig 5, with heater for the water,	£95
Mason-work, building a suitable, substantial brick chimney, as in fig. 5, setting engine and boiler, and supplying water, or making a well, ...	55
	£150

Engine of 6-horse power, as shown in figs. 1 and 3, with 10-inch cylinders, 2 feet stroke, boiler 14 feet long, 3 feet 8 inches diameter, 5-16ths thick, with same appurtenances as preceding, (by another maker the charge is £110,) . .	£120
Mason-work, nearly same as preceding, . .	60
	£180

Engine of 8 or 9 horse power, same as shown in figs. 1 and 3, and with 11-inch cylinder, 2 feet stroke, boiler 16½ feet long, 3 feet 8 inches diameter, 5-16ths thick, . .	£140
Mason-work, about same as preceding, . .	65
	£205*

It is thus seen that there is in reality a considerable saving in erecting a substantial fixed engine, including even a brick chimney and mason-work, than purchasing a portable one, which cannot be erected so cheaply, even exclusive of connecting and mason-work.

It is unnecessary to pursue the subject further, the advantage obviously being in favour of the fixed engine, supposing both engines were applied to a fixed thrashing-machine. As respects expense of maintenance, the advantages are equally strong in behalf of the fixed engine. Many of these have been for years in use, and require no repairs. The stability of the fixed engine, as already pointed out, insures its durability, and the boiler is much less liable to get deranged than the tubular boiler, while it is much more easily repaired. As respects fuel, the quantity in either case varies so little, as to be undeserving of consideration; but the advantage with the common boiler is, that the dross of coal answers the purpose, which lessens the expense considerably. But in every estimate made of the consumption of fuel, unless the quality of coal is duly taken into consideration, any result by comparison will give an erroneous deduction. One great advantage of the fixed engine and boiler, is the certainty of a sufficient supply of steam—a point of great importance for any engine to perform its duty efficiently. From the great draught of the boiler from the blast-pipe of the portable engine, and rapid combustion of fuel, constant attention to the fire is required, otherwise the steam gets rapidly down. At a trial made under the observation of the writer, the stoker had to feed the fire every five to ten minutes. Unless great attention is paid, the consumption of fuel will be considerable.

As respects the amount of work done, a common six-horse

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* If these engines are erected at a distance from the manufactory, a small additional sum is charged to cover carriage, travelling expenses of men, &c.

power overhead crank-engine may be contrasted with a nine-horse portable engine, both engines being erected in the old horse-walk of a barn, and attached to a fixed thrashing-machine there, as in fig. 5, or, if preferred, to one of the common thrashing-machines, with cast-iron framing unconnected with the barn. The portable engine being placed in the horse-shed, fig. 5, and the power conveyed to the mill by means of a strong leather belt passing over a pulley or fly-wheel upon the engine, 5 feet diameter, to another pulley overhead 18 inches diameter, fixed at the end of a horizontal shaft leading and attached to the drum of the mill—the drum-shaft revolving at the rate of about 400 revolutions per minute. There is a spare pulley on the other end of the crank shank of the engine, from which the power might be applied to drive other machines. The engine has two cylinders placed upon the top of the tubular boiler, the pistons of which move at the rate of from 100 to 114 strokes per minute. The steam is usually worked at a pressure of 30 lb. on the square inch. The combustion being rapid, almost constant attention is requisite to the feeding of the fire to keep up the steam with regularity. At the trial made, the average quantity of fuel used was at the rate of 1 cwt. of good chew-coals per hour, which, supposing the horse-power as stated, nine, will give 12$\frac{4}{9}$ lb. per horse-power per hour—the quantity estimated by the makers being 9 cwt. in 10 hours. There being little recipient for the steam, it passes off as fast as it is generated. The iron funnel, or smoke-pipe, passing through the tile-roof of the horse-walk only a few feet, the whole pipe not being more that 10 feet, the smoke is very offensive, and a considerable nuisance arises from this, and sparks and cinders arising from it—the latter might partially be obviated. This nine-horse-power portable engine drives a six-horse-power mill with refuse elevators, and elevators to drive two dressing-fans; and it does the duty, were it not from the difficulty of watching the fire to keep up the steam; and there is a constant shaking or vibration of the framework of the engine the instant the sheaf passes through the mill, and until another sheaf enters the rollers. At one time the rapidity of the strokes of the engine rapidly increases from this inequality of motion: at another time it decreases, which makes the shaking of the whole framework of the engine very perceptible. From repeated trials, it appeared that the estimated work that could be done, was to thrash at the rate of 4 to 5 quarters of sickle-cut wheat per hour. At one trial it thrashed at the rate of 40 bushels per hour before the grain passed through the second dressing-fans, and therefore was in an unfinished state. This calculation, however, differs considerably from the printed accounts published. It is probable, however, that these statements are estimated from wheat with short straw, the grain being merely

thrashed with a common mill without being dressed. In another published statement respecting one of the portable engines with a tubular boiler, by another maker, the consumption of fuel is given out as less than that of other portable engines, and at the rate per horse-power of the best reciprocating condensing engines. These statements, however, must be taken with reservation, from the fact that the quantity of fuel required in economical evaporation depends so much upon the quality of the fuel, and the means taken to prevent condensation and retain the caloric evolved; while the mere quickness of the evaporation is dependent upon the area of surface exposed to heat.

From repeated trials of stationary reciprocating engines at farmsteads, both condensing and non-condensing, beam, overhead crank, side-lever, and horizontal engines, the power and quantity of work capable of being performed with a moderate quantity of fuel has been so fully established, and is so well known, that it seems next to supererogation to enter into details upon the subject.

At a trial made with a five-horse-power condensing engine, which made 48 strokes per minute, attached to an old heavy mill, with two sets of elevators, one to carry up the refuse corn, and the other to work dressing-fans, about as much work was done with the dross of coals, as with the nine-horse-power portable engine, while the steam was easily maintained, the fire not requiring more attention than to be looked at once in twenty minutes. The surplus steam from the boiler was applied to drive a bruising-machine, as also the spare steam to cook food for cattle. The engine had been fifteen years in use, and was as entire as when first erected.

At another trial with an eight-horse-power high-pressure overhead crank-engine, on two fixed pillars, figs. 1 and 4, the engine going at the rate of from 50 to 60 strokes per minute, the stroke 2 feet, cylinder 11 inches diameter, there being an intermediate wheel between the crank and spur-wheel, taking a little more power, more work was done in the same time than with the portable engine, while the grain passed through two dressing-fans by means of elevators worked by machinery in a state for the market. The boiler was a cylindrical one—the pressure of the steam 40 lb. —the quantity of fuel was about 10 lb. per horse-power; indeed, it is rarely that an engine boiler can be worked at less than 10 lb. per horse-power per hour; but much will depend, as stated, upon the quality of the coal.

At another trial with a similar engine and boiler of six-horse power, figs. 1 and 2, with a lighter and more modern construction of a fixed thrashing-machine, 5 quarters of wheat with strong straw were easily thrashed per hour, the difficulty being not so much

the quantity that the mill can pass through, as in the extra labour required of hands to feed and to take away the straw: average weight of wheat about 60 lb. per bushel—straw 4 to 4½ feet long.

The average quantity of work done easily at the Scotch farmstead, with a six-horse power stationary steam-engine and thrashing-machine, is from 4 to 5 quarters of clean-dressed wheat per hour; but as much as 50 of wheat to 80 bushels of oats per hour, or even more, could be thrashed with these mills, if the shakers could take away the straw. The average quantity thrashed by these mills, it is hardly necessary to observe, estimated by the measurement of the grain when thrashed, will depend upon the state and length of the straw, and the kind and weight of grain.

In the engine above alluded to, the average quantity of fuel consumed was at the rate of 10 lb. chew-coals per horse power per hour, or from 10 to 16 lb. dross: with stronger and better fuel, economically used, the average could be reduced to about 7 to 8 lb. per horse power per hour, or the best amount of duty performed. At repeated trials made at farms with overhead crank and beam engines, at from 6 to 10 horse power, with oblong boilers, the average quantity of fuel consumed was at the rate of about 8 to 10 lb. of good coal per horse power per hour, to keep up the steam. It is usual, however, to allow, on a rough estimate, 1 cwt. of dross or culm per hour for a six-horse power engine, and about ¾ cwt. of large coal, the whole expense of which would not exceed in coal districts the small sum of from 3d. to 6d. per hour. At the farm last referred to, the arrangement of engine and mill is as perfect as can be desired for a farm of moderate extent. The grain is passed at one operation through the mill in a fit state for market. The whole cost of engine and mill, exclusive of the building, did not exceed £200, of which the mason-work and carriage were £60.

The following example may be given of a very complete six-horse power overhead crank-engine, (figs. 1 and 2.) The cylinder is 10½ inches, 21 inches stroke; boiler, 15 feet long, 3 feet 8 inches diameter; plate, $\frac{5}{16}$ths thick; erected complete, exclusive of mason-work, for £120. Thrashing machine, on a most improved principle, with partition across the barn, rollers 4 feet long, drum, with beaters, 3 feet in diameter—(the drum of the peg-beater machine is made less in diameter;) 2 shakers 5 feet diameter; 2 chaffing-fanners and riddles within the mill itself; framing, gearing, &c. put up, £55; elevator for the roughs, £10; 1 horizontal barley hummeller, £5; 1 extra hand-fanner, worked by elevator, £7, 10s.; elevator for the hummeller and fanner, £5; in all, amounting

to	£202	10	0
A strong corn-bruiser, driven also by same engine,	12	0	0
	£214	10	0

The drum and rollers are driven by wheels and pinions, and the shakers by a chain, the hummellers, elevators, and fanners by a belt; the rollers having a reversing motion, and the power of being thrown out of gear. The drum makes 320 revolutions in a minute. This mill will thrash easily two quarters of dressed barley in twenty minutes, which is at the rate of six quarters per hour—the quantity of fuel consumed is very moderate, less than 1 cwt. per hour, and the steam is easily kept up. The engine has been long in use, and requires no repairs. The barn is 10½ feet high, to give height to two fanners.

The expense of a crank engine by another maker, fully 8 to 10 horse power, (figs. 1 and 3,) with a cylinder 11½ inches diameter, 2 feet stroke, boiler 18 feet long by 3⅝ feet diameter, with a mill 4 feet 6 inches wide, and proportionally heavier and stronger, exclusive of a second set of elevators and fanner, and horizontal hummeller—the drum cover being adapted for the latter—£225.

From these observations it will be perceived, that the difference does not so much lie between the work capable of being performed with fixed and locomotive engines, and the quantity of fuel consumed, as in the manner in which the work itself is performed. Nor does the mere rapidity at which the work is done signify so much as the efficiency and perfect manner in which it is done. Thrashing is generally quickly enough performed for every useful purpose. The opinion of the most experienced millwrights of the present day is, that it is not desirable to give too much speed to the drums of the beater Scotch thrashing-machine; and from 300 to 350 revolutions per minute seems to be the utmost speed that the machine should have;—the peg-beater has generally a greater velocity. Indeed, the main purpose of the thrashing machine is obviously not the rapidity of the motion by which the grain is beaten out, and the passage of the straw through the mill as fast as it can be fed, which can be of no importance or practical utility; but the thrashing clean and steadily, and to thoroughly separate the grain from the straw, as the more rapidly the work is done, the more hands are required to do it. The fact is well known, that the improved Scotch stationary thrashing-machine, with two shakers, and elevators, and cleaning fanners, all worked together by the motive power, performs the operation of thrashing and cleaning the grain in the most perfect manner. The steam power, with such a machine, thrashes and dresses the grain by one operation for the market; whereas with the portable machines, applied to such engines, the thrashing and dressing the grain are, in general, two separate operations. The portable thrashing-machines, in most common use in England, and where mowed grain is the usual state, seem to claim their merits upon the rapidity of the motion, the motion of the

drum being equal to 600 to 800 revolutions per minute—no feeding-rollers being used for many of such machines, the drum being an open skeleton, and the action of thrashing being a compound of beating and rubbing. In the various thrashing-machines constructed on such principles, the thrashing process is always more or less defective, and the grain is imperfectly separated from the straw, while the dressing of the grain is not combined with the thrashing. For such what may not be improperly termed defective machines, portable engines with rapid action may be well adapted; but the process cannot be recommended for the adoption of the agriculturist who wishes to avail himself of every useful improvement. Such plans are not, surely, entitled to receive, without proper qualification, the countenance and support of scientific bodies, whose opinion is important in elucidating facts, and by the impress of whose opinion much good or evil may be done. The English plan, so extensively adopted, of thrashing in the field, for which their portable engines have been chiefly constructed, seems to present, as has been noticed, no advantages worthy of adoption, or even deserving of encouragement. The farmstead and the rick-yard, in the opinion of the writer, should bear the aspect of a manufactory, where every arrangement made should tend to convenience and tidiness, economy and comfort.

The question seems to present itself, then, whether a fixed engine and thrashing-machine, going at a moderate speed, capable of performing every duty required of it with safety, economy, and stability, and easily maintaining the steam, is or is not to be preferred to a portable engine applied to a stationary thrashing-machine, moving with great rapidity of speed, and in constant state of vibration, and requiring the most careful attention to the fire to keep up the steam—otherwise, the steam-power is instantly diminished, and has again to be brought up? The answer to this question hardly admits of a doubt. The fixed engine, in every point of view, must be better adapted for the fixed farm machinery than the portable one, although by some persons the latter has been commended. From the effect of the rapidity of motion of the steam piston, no care in workmanship can prevent the wear and tear and leakage resulting from its action. A farmer, who has many things to attend to, is not to be expected to trouble himself, if he could avoid it, with a boiler which requires almost constant watching, where the tubes are liable to get obstructed, and frequently require cleaning out, and where, from their perishable nature, they must necessarily soon wear out, from the constant action of the cinders and ashes upon the interior. Another cause of the want of durability of the tubes arises from the want of an equal expansion between the case of the boiler and the tubes—besides which, the tubes are liable to burst, when danger will arise from the steam rushing out, and the ashes being blown

about. To this must be also taken into consideration the inconvenience of renewal of the tubes at a farm in the country, often distant from engineers or workmen. Considerable annoyance will also arise from the smoke from the short engine-funnel creating apprehension of fire in the farmstead. To this may be added the dread, to the inexperienced, that the rapidity of the action of the engine will shake the frame, and that it will knock itself to pieces.

To compensate for these manifest disadvantages of portable or locomotive engines, when applied to fixed thrashing-machines, there is on the opposite side of the picture the advantage that they can more easily be applied to the thrashing-machine than the fixed engine, and that, although the cost of them may be more than the fixed engine, the latter point is so far counterbalanced that the chimney-stalk and the building of a boiler may be dispensed with; and, lastly, that the farmer, when he removes from his farm, can carry his engine to another farm, like a piece of furniture—whereas, if he has built the chimney and engine-buildings at the farmstead, he cannot remove them. In general this is a rare circumstance, as in most cases the landlord is at the expense of building the chimney and engine-house. In cases, however, where no encouragement is given to tenants, or where the steam power is only required for a temporary purpose, the portable engine may be had recourse to; but in general, a farmer will have more prudence and judgment than to adopt a plan of this kind, if he can avoid it. One Scotch farmer, indeed, has stated that he gives a preference to a portable engine, from the little fuel and oil consumed; that it requires no farm-buildings, and can be easily attached to a thrashing mill; and that, at the end of a lease, it could be easily removed and disposed of. This opinion appears to be given without sufficient investigation. It is apparent that these reasons, and those previously alluded to, in reference to field thrashing, embrace all that can be said in its behalf, otherwise they would have been adduced. It is readily admitted that various instances may arise where the application of these may be useful on farms. The writer may suggest a case where the use of a portable engine might be useful, as in a part of the country where the farms are very small—a few farmers joining together might have an engine amongst them. However, as respects saving, when such an engine is contrasted with a common engine at a farm, either as to first cost of erection, or subsequent maintenance, or saving of fuel, the idea is chimerical; and as to advantages to be derived from being more easily attached than a fixed engine, and also as to being easily disposed of at the end of a lease, the writer doubts very much whether it would not be fully as difficult to dispose of one of these locomotive farm-engines to advantage as to dispose of a superior fixed reciprocating beam or crank engine. From what has been observed, it must be obvious that cases will occur where

the adoption of the one plan or the other must be regulated by circumstances and convenience. The utility of both plans in certain cases will be apparent, and it becomes of importance that, in the adoption of either, the engines should be the best of their kind, and free from those objections which have been sometimes found by experience to appertain to the use of steam-power at farms. It is, however, important to keep in view, that in the adoption of any plan of steam-engine, as a motive power—or, indeed, in using any kind of machinery whatever at the farm—too much attention cannot be paid to simplicity of construction. Every part of machinery should be strong, simple, easily understood, easily kept clean, and in good working order, and easily repaired; and it will be found upon examination that, in general, these points have been carefully attended to by the Scotch engineers and millwrights in the erection of the fixed steam-engines and thrashing-machines in the better cultivated districts of Scotland and the English border; and that these fixed engines have already, as previously noticed, been advantageously and beneficially applied to various useful purposes in the barn, and that every day is pointing out new and judicious applications of the motive power. The advantage of having more ample power in the engine is becoming apparent—instead of 6-horse power, the engine has been usefully increased to 12-horse power. Already has steam power been advantageously applied, besides thrashing and dressing the grain, to working the force-pump which impels liquid manure through pipes, and to distributing it over the fields—to churning at the dairy—and to driving various machines—the steam itself being economically applied to cooking food for cattle—steaming dairy utensils, and many other useful purposes.

PREMIUMS AWARDED BY THE SOCIETY IN 1851.

CLASS I.—REPORTS.

1. The gold medal to the Right Hon. Lord Kinnaird, Rossie Priory, Perthshire, for Report and Plans of Cottages Improved on his Estate.
2. The gold medal to William Forman Home of Wedderburn, Berwickshire, for Report and Plans of Cottages Erected on his Estate.
3. The gold medal to Andrew Douie, Factor, Blair-Adam, Kinross, for a Report on Draining.
4. The gold medal to Richard Hodgson of Carham Hall, Northumberland, for a Report on the Cultivation of Flax.
5. The gold medal to James Farquharson, Craig House, Kincardineshire, for a Report on the same subject.
6. The gold medal to Walter Reid, Drem, East-Lothian, for a Report on the same subject.
7. The gold medal to said Walter Reid, for a Report on the Comparative Advantages of Fattening Cattle in Stalls, in Loose Houses or Boxes, and in Sheds or Hammels.

8. The gold medal to William Goodlet, Factor for Lord Blantyre, for a Report on the Progressive Improvement of three lots of Cattle fed on Turnips raised with different Manures.
9. The gold medal to Robert Bell, Architect, Edinburgh, for the best Plan of a Farm-Steading, lodged in Competition in 1850.
10. The gold medal to John Starforth, Architect, Edinburgh, for the best Plan of a Farm-Steading, lodged in 1851.
11. The gold medal to Robert Boyle, Ayr, for a Report on the different Drain Tile and Pipe Machines brought out within the last fourteen years.
12. The medium gold medal to Dr Hugh Cleghorn, H.E.I.C.S., for a Report on the Hedge Plants of India.
13. The medium gold medal to Finlay Dun, Junior, V.S., Edinburgh, for a Report on Feeding and Shelter connected with Diseases in Cattle and Sheep.
14. The medium gold medal to George W. Hay of Whiterigg, Melrose, for a Report on Varieties of Barley.
15. The medium gold medal to James Fulton, late Jameston, Ayrshire, for a Report on the Cultivation and Uses of Chicory.
16. The medium gold medal to James Ritchie, C.E., Stornoway, for a Report on Tussac-Grass, grown in the Lews.
17. The medium gold medal to Peter Mackenzie, West Plean, Stirlingshire, for a Report of Planting on Peat Moss.
18. The medium gold medal to David Gorrie, Annat Cottage, Errol, for a Report on the Cottage Accommodation of the Carse of Gowrie.
19. The medium gold medal to Robert Milne, C.E., Aberdeen, for a Report on the Application of Special Manures.
20. The medium gold medal to William Alexander of Springhill, Peterhead, for a Report on the Improvement of Waste Land.
21. The silver medal to Sir David Kinloch of Gilmerton, Bart., East-Lothian, for Report and Plans of Cottages Erected on his Estate.
22. Five Sovereigns to John Stephen, Crossroads of Keig, Aberdeenshire, for a Report on the Improvement of Waste Land.

Class II.—LIVE STOCK—DISTRICT COMPETITIONS.

I. CATTLE.

I. *Counties of Moray and Nairn.*

Honorary Premium.

Bulls. His Grace the Duke of Richmond, Gordon Castle, Silver Medal.

Money Premiums.

Bulls.	1. Alex. Sutherland, Shempston, Elgin,	L.10	0	0
	2. John Cruickshank, Cloves, Alves,	5	0	0
Heifers.	1. Arthur Reid, Stynie, Fochabers,	5	0	0
	2. Robert M'Kessack, Grangegreen, Forres,	3	0	0

2. *District of Kintyre.*

Bulls.	1. Neill Nicholson, Backs, Campbeltown,	L.10	0	0
	2. James Wilson, Auchaleck, Campbeltown,	5	0	0

Heifers.	1. James Wilson, Auchaleck,	L.5 0 0
	2. John Mitchell, Ballimenach, Campbeltown,	3 0 0

3. County of Fife.

Bulls.	1. William Fortune of Muircambus, Colinsburgh,	L.10 0 0
	2. Robert Haig, Seggie, Leuchars,	5 0 0
Heifers.	1. Andrew Aitken, Carnbee, Colinsburgh,	5 0 0
	2. David Wallace, Balgrummo, Leven,	3 0 0

4. County of Wigtown.

Bulls.	1. Andrew Frederick, Freugh, Stranraer,	L.10 0 0
	2. John Lockhart, Kirminnoch, ditto,	5 0 0
Heifers.	1. Robert Cochran, North Cairn, ditto,	5 0 0
	2. William Dorman, Deer Park, ditto,	3 0 0

5. County of Linlithgow.

Bulls.	1.* John Montgomery, Cowhill, Whitburn,	L.5 0 0
	2.* Alex. Fleming, Kinneil Mills, Linlithgow,	2 10 0
Heifers.	1.* Henry Reid, Haining Valley, Linlithgow,	2 10 0
	2.* Alex. Fleming, Kinneil Mills,	1 10 0

6. District of Nithsdale.

Bulls.	1. John Harper, Townfoot, Thornhill,	L.10 0 0
	2. H. D. B. Hyslop, Tower, Sanquhar,	5 0 0
Heifers.	1. H. D. B. Hyslop, Tower,	5 0 0
	2. James Kennedy, Brandleys, Sanquhar,	3 0 0

II. DRAUGHT HORSES.

1. District of Annandale.

Stallions.	James Proudfoot, Templand Village, Lochmaben,	L.25 0 0
Mares.	Thomas Tinning, Tinwald House, Dumfries,	10 0 0
Fillies.	Misses Maxwell, Bankhead, Canonbie,	5 0 0

2. County of Dumbarton.

Stallions.	Samuel Clark, Manswarry, Kilbarchan, Renfrewshire,	L.25 0 0
Mares.	James Gray, Blawarthill, East Kilpatrick,	10 0 0
Fillies.	John Findlay of Batturich, Dumbarton,	5 0 0

3. County of Caithness.

Colts.	Alexander Burnetson, Clayock, Wick,	L.5 0 0

III. SHEEP.

Leicester Breed.

1. District of Kelso.

Honorary Premium.

Tups.	John Black, Ford—Westfield, Coldstream,	Silver Medal.

* Half-premiums awarded, the number of lots being under six.

MONEY PREMIUMS.

TUPS.	John Davison, Brandon—Whitehouse, Whittingham, Northumberland . .	L.7 0 0
SHEARLING TUPS.	Thomas Cockburn, Sisterpath, Dunse, .	7 0 0
EWES.	George Thomson, Haymount, Kelso, .	5 0 0
GIMMERS.	Thomas Cockburn, Sisterpath, Dunse, .	4 0 0

2. *County of Forfar.*

HONORARY PREMIUM.

TUPS. Right Hon. Lord Kinnaird, Rossie Priory, Inchture, Silver Medal.

MONEY PREMIUMS.

TUPS.	Wm. Ruxton, Farnell, Brechin, .	L.7 0 0
SHEARLING TUPS.	Wm. Ruxton, Farnell, . .	7 0 0
EWES.	Hugh Watson, Keillor, Coupar-Angus.	5 0 0
GIMMERS.	Hugh Watson, Keillor, . .	4 0 0

CHEVIOT BREED.

1. *County of Sutherland.*

HONORARY PREMIUM.

TUPS. Evander M'Iver, Scourie, Golspie, . . . Silver Medal.

MONEY PREMIUMS.

TUPS.	Wm. and James Gunn, Glendhu, Golspie,	L.5 0 0
SHEARLING TUPS.*	Wm. and James Gunn, Glendhu, .	2 10 0
EWES.	Patrick Sellar, Morvich, Golspie, .	5 0 0
GIMMERS.	Alex. Craig, Craigton, Golspie, .	4 0 0

2. *District of Selkirk.*

TUPS.	Thomas Haliburton, Tushalaw, Selkirk,	L.5 0 0
SHEARLING TUPS.*	Andrew Easton, Todrig, Ashkirk, .	2 10 0
EWES.	Thomas Haliburton, Tushalaw, .	5 0 0
GIMMERS.	Thomas Haliburton, Tushawlaw, .	4 0 0

3. *Districts of Annandale and Eskdale, &c.*

HONORARY PREMIUM.

TUPS. Thomas C. Borthwick, Hopsrig, Langholm, . Silver Medal.

MONEY PREMIUMS.

TUPS.	William Paterson, Twiglees, Lockerbie,	L.5 0 0
SHEARLING TUPS.	James Moffat, Garwald, Langholm, .	5 0 0
GIMMERS.*	Thomas C. Borthwick, Hopsrig, .	2 0 0

BLACKFACED BREED.

1. *Island of Arran.*

TUPS.	Robert Crawford, Glenscorrodale, Kilmory, Class II.,† . . .	L.5 0 0

* Half-premiums awarded, the number of lots being under six.
† Class II., Tenants paying under £150 of rent.

SHEARLING EWES.*	Alex. M'Nicol, Monyquil, Kilmory, Class II.,	L.2 0 0

2. *District of Argyll.*

TUPS.	Alex. Campbell of Auchindarroch, Lochgilphead, Class I.,†	L.5 0 0
EWES.*	Alex. Campbell of Auchindarroch, Class I., .	2 0 0

3. *District of Kinloch-Rannoch.*

TUPS.	Alex. M'Donald, Junior, Kinloch, Fortingal, Class I.,	L.5 0 0
TUPS.*	Alex. M'Naughton, Pubil, Fortingal, Class II., .	2 10 0
EWES.	James Menzies, Auch, Glenorchy, Class I,, .	4 0 0
EWES.*	Donald M'Gregor, Tomchaorin, Fortingal, Class II.,	2 0 0

SHEEP SHEARING.

William Burns, Ladykirk, Berwickshire—Silver Medal.

IV. SWINE.

Parish of Inveraven, &c.

HONORARY PREMIUM.

BOARS. Sir George Macpherson Grant of Ballindalloch, Bart.—Silver Medal.

MONEY PREMIUMS.

BOARS.	1. George Smith, Minmore, . . .	L.3 0 0
,,	2. Lewis Cumming, Cardow, . . .	2 0 0
,,	3. Robert Hay, Ruechlerich, . . .	1 0 0
SOWS.	1. Robert Hay, ditto, ...	2 0 0
,,	2. George Smith, Minmore, . . .	1 5 0
,,	3. Lewis Cumming, Cardow, . . .	0 15 0

CLASS III.—DAIRY PRODUCE.

District of Ardrossan.

I. BUTTER.

1. John Gray, Sorbie, Ardrossan, . . .	L.3 0 0
2. John Hamilton, Capringstone, Dreghorn, . .	2 0 0
3. Hugh Hunter, Poteath, West Kilbride, . .	1 0 0

II. CHEESE.

1. A. B. Aitken of Newton, West Kilbride, . .	L.3 0 0
2. James Miller, Stanley, ditto, . . .	2 0 0
3. William Cunningham, Eglinton Mains, . .	1 0 0

CLASS IV.—CROPS AND CULTURE.

I. SEEDS.

The Silver Medal has been awarded to the following parties :—

1. *County of Renfrew.*

1. Robert Langmuir, Whiteford, Paisley, for White Wheat.

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* Half-premiums awarded, the number of lots being under six.

† Class I., Proprietors or Tenants paying more than £150 of rent.

2. William Glen, Hawkhead Mains, Paisley, for Beans.
3. James Forster King, West Longhaugh, Bishopton, for Potatoes.

2. *District of Buchan.*

1. Robert Milne, Woodhead, for Early Berlie Oats.
2. John Mackay, Moss-side, for Perennial Rye-Grass Seed.

3. *County of Haddington.*

1. T. S. Mitchell Innes of Phantassie, Haddington, for Chevalier Barley.
2. Do. for Common Barley.
3. Thomas Cockburn, Sisterpath, Dunse, for Potato Oats.
4. James Aitchison of Alderston, for Hopetoun Oats.
5. David Park, Tynefield, Dunbar, for Sandy Oats.
6. A. B. Wright, Hedderwick Hill, Dunbar, for Field Beans.

4. *District of Wester Ross.*

1. John Binning, Brae, Dingwall, for White Wheat.
2. Hugh Innes Cameron, Arcan, do., for Common Barley.
3. James Dudgeon, Fodderty, do., for Sandy Oats.
4. James Ure, Courtown, do., for Perennial Rye-Grass Seed.

5. *County of Inverness.*

1. Angus Macdonald of Glenalladale, Beauly, for White Spring Wheat.
2. John Walker, Castle Stuart, Inverness, for Common Barley.
3. Arthur Forbes of Culloden, Inverness, for Potato Oats.

II. TURNIP SEED.

District—County of West Lothian.

The gold medal to Thomas Gillespie, Hillend, for the best Purple-Top Swedish-Turnip Seed.

III. GREEN CROPS ON SMALL POSSESSIONS.

The Quoad Sacra Parish of New Pitsligo.

1. John Park,	L.3	0	0
2. William Presley,	2	10	0
3. Peter Cadger,	1	10	0
4. Charles Benge,	1	0	0

IV. MEDALS IN AID OF PREMIUMS GIVEN BY LOCAL SOCIETIES.

1. *County of Nairn.*

William Clark, Easter Brightmony, for Best Managed Farm.

2. *District Ballindalloch.*

William Robertson, Burnside, for Best Managed Farm.

3. *District of Bute.*

Mrs Ninian Duncan, Upper Scoulag, for Best Managed Dairy.
Robert M'Alister, Mid Ascog, for Best Managed Green Crop.

4. *District of Breadalbane.*

John Macpherson, Kenmore, for Best Managed Green Crop.

5. *County of Inverness.*

James Masson, Gorthlick Mains, for the Best Managed Green Crop.

6. *Rossie Priory—Perthshire.*

John M'Laren, Mill Hill, for Best Turnip Crop, grown on Black land.
Robert Just, Aithmuir, for Best Turnip Crop, grown on Clay land.

V. PLOUGHING COMPETITIONS.

In the course of the year the Society's Medal was awarded at seventy-one Ploughing Competitions, the details of which are given in a previous part of this volume.

CLASS V.—COTTAGES.

FOR THE BEST KEPT COTTAGES AND GARDENS.

1st Cottage Premium—L.1, 5s., and Medal when 4 Competitors; 2d,—L.1; 3d,—15s. Garden Premium—L.1, and Medal when 4 Competitors.

County of Ayr.

DALRYMPLE.—1st Premium and Medal to Benjamin Rigg; 2d, John Sinclair; 3d, James Bowie. Garden Premium to William Aird.

County of Berwick.

AYTON.—1st Premium and Medal to Thomas Anderson; 2d, Adam Hughes; 3d, James Aitchison. Cottage Medal to Adam Gibson.
BUNCLE.—1st Premium and Medal to James Merton; 2d, George Lindsay; 3d, Robert Thomson. Garden Premium and Medal to James Moffat.
COCKBURNSPATH.—One Sovereign to Jane Kerr. Garden Premium to John Dunn.
COLDINGHAM.—1st Premium and Medal to Peter Robertson; 2d, Adam Hewit; 3d, Thomas Kinghorn. Garden Premium to John Watt.
COLDSTREAM.—1st Premium and Medal to Peter Carp; 2d, John Carr; 3d, William Carp. Garden Premium and Medal to William Rutherford.
EDROM.—1st Premium and Medal to John Penney; 2d, William Wilson; 3d, Thomas Kinghorn. Cottage Medal to James Aikman. Garden Premium and Medal to Robert Kinghorn.
EYEMOUTH.—1st Premium and Medal to Mrs Cow; 2d, Alexander M'Gechan; 3d, Thomas Swanston.

FOULDEN.—1st Premium and Medal to William Burnet; 2d, James Johnston; 3d, Andrew Lunn.

HUTTON.—1st Premium and Medal to George Hewit; 2d, Thomas Cleghorn; 3d, George Clagie. Garden Premium and Medal to James Clagie.

LADYKIRK.—1st Premium and Medal to John Rainton; 2d, John Lindores; 3d, Andrew Moscripp. Cottage Medal to James Kerr. Garden Premium and Medal to William Burn.

WHITSOME.—1st Premium and Medal to William Trotter; 2d, Robert Younger; 3d, Robert Purvis. Garden Premium and Medal to Ebenezer Paterson.

County of Forfar.

CRAIG.—1st Premium and Medal to Alexander Wright; 2d, Charles Falconer; 3d, James Birse. Garden Premium and Medal to David Burness.

County of Perth.

REDGORTON.—1st Premium and Medal to Robert Cairns; 2d, Charles Lawson; 3d, Thomas Garvie. Cottage Medal to David Ellison. Garden Premium and Medal to Robert Cairns.

VETERINARY COLLEGE.

The Silver Medal was awarded to each of the following parties:—

1. John Darcey Peech, Pontefract, Yorkshire, for best General Examination.
2. James Collins, Birmingham, for best Examination in Veterinary Medicine and Surgery.
3. Charles Moir, Paisley, for best Examination in Anatomy and Physiology.
4. Joseph Ball, Manchester, for best Examination in Chemistry.
5. John Darcey Peech, Pontefract, for best Examination in Materia Medica.
6. John Darcey Peech, Pontefract, for best Essay on the Chemistry of Urine.
7. Charles Moir, Paisley, for the best Anatomical Preparations.

Premiums not applied for within two years from the date of this notice will be forfeited.

By Order of the Directors.

JN. HALL MAXWELL, *Secretary.*

EDINBURGH, 10*th February* 1852.

ON THE CULTIVATION OF FLAX.

I.—By RICHARD HODGSON, Esq. of Carham, Northumberland.

[Premium—The Gold Medal.]

HAVING for some years sown a few acres of flax, with the view of ascertaining its value in comparison with crops in ordinary culture, and of supplying myself with linseed for my stock, I am induced to give a narrative of the results.

In the years 1850 and 1851 only, the portion of land under flax amounted to five acres, and to these seasons I therefore confine myself, in a statement of the comparative expenditure and produce of that with an equal portion of land occupied by oats. The comparison is perhaps the more complete, inasmuch as the rotation has been inverted in these years, viz., flax after oats, and oats after flax—each portion having been previously under the same course of tillage.

I may be allowed to state that my experience on a smaller scale has satisfied me that, where the land has been fairly treated, (that is, kept clean, and compensated by manure for the abduction of the entire crop of seed and straw,) no depreciation of future crops, whether cereal or radical, can be detected; on the contrary, the depth and accuracy of tillage, and perfect emancipation from weeds, necessary to the successful cultivation of flax, to say nothing of its brief occupancy of the ground, (little more than four months,) and its independence of artificial aid to moderately fertile soil, may be advanced as bases for the opinion, that the *whole* crop, seed and fibre, of flax, may be removed with less detriment to succeeding crops than the *whole* of *any other* crop in ordinary culture; and where the seed, or its equivalent in the shape of manure, is, as it ought to be, restored to the land, few will question the superior efficacy of such a return to that rendered by the straw alone of any of our cereal crops.

It is true that the compensatory value of the seed admits of considerable qualification, according to the actual crop which has been raised, since, if flax be sown thin, (say 1 or 1½ bushels to the acre,) it will produce an abundant and well-filled head of seed, with strong coarse fibre of inferior quality; while, if the seed have been thickly sown, (say 3 or 3½ bushels to the acre,) the fibre will be finer, free from branches, the bolls comparatively rare, and the seed less plump. Still, if the conclusion drawn from the experiments of Sir Robert Kane, and Messrs Way and Ogston, may be relied on, the exhaustion of the soil is to be measured rather by

the quantity of *seed* produced than of *fibre;* and I am disposed to maintain the proposition, that "if the whole of the seed (or its equivalent) be restored to the soil in the shape of manure, a crop of flax exacts less from land than any grain or root crop in cultivation."

I will now proceed to state methodically the circumstances under which my crops of 1850 and 1851 were grown, and the comparative expense and profit per acre of flax and oats.

The land consists of 10¼ acres of medium quality, upon limestone and whin rock; its composition is thus defined by Dr Anderson:—

Water,	3.99
Organic matter,	5.02
Peroxide of iron and alumina,	4.57
Lime,	0.58
Silicious matter,	83.81
Magnesia, potash, soda, Sulphuric acid and phospheric acid,	2.03
	100.00

Its altitude is about 150 feet above the level of the sea, being 17 miles distant from the eastern coast of Northumberland.

It had previously been farmed upon the five-shift, and

In 1848 was cropped with barley, and sown with clover.

In 1849, hay was cut.

In 1850, flax to the extent of 5¼ acres, and oats of 5 acres, were substituted for the usual rotation of the second year's grass; ¼ acre, however, of flax was sown for the ensuing year's seed, and therefore the comparison will be made upon a like portion for each crop—viz., 5 imperial acres.

In October 1849 the land was drained where requisite; and the following extracts from my farm-journal will show the management and produce in each case:—

1849. Flax—1850.

Nov. 30.—First ploughing.

1850.

Mar. 27.—Second ploughing and subsoiling.

April 5.—Land harrowed and rolled twice.

— 8.—2¾ bushels linseed to the acre, sown broadcast, harrowed in with a common light harrow, and rolled. The seed was grown in England in 1849, from Riga seed imported in 1848–9, and weighing 51½ lb. per bushel.

— 11.—Weeds and roots of grass removed.

— 21.—Flax brairded.

July 2.—Flax in full bloom.

Aug. 13 to 21.—Crop pulled, bound, and set up.

— 30.—Stacked.

Oct., &c.—Rippled; straw sent to Newcastle to be steeped and scutched, and the seed cleaned for market and home use.

	Tons.	Cwt.	Qrs.
Produce per acre:—Raw straw,	2	11	2
	Cwt.	Qrs.	Lb.
Giving, of Flax,	6	3	14
— Tow,	1	1	14

And of seed, 16 bushels, weighing 56½ lb. per bushel; chaff, green seed, &c., 64 bushels.

N.B.—A per-centage must be deducted from the weight of the raw straw, on account of seed and chaff accidentally mixed with the straw in rippling.

Outlay on Flax Crop—1850.

Rent of 5 acres, tithe free, at £2, ...	£10 0 0
Rates, taxes, and public burthens, ...	0 15 0
Seed, 13¾ bushels, at 10s., ...	6 17 6
Ploughing, November and December 1849, . .	1 10 0
Do. and subsoiling, March 1850, ...	2 10 0
Harrowing and rolling, do., ...	1 0 0
Sowing, harrowing, and rolling, April do., . .	0 18 6
Weeding, ...	0 4 6
Pulling, binding, and setting up, August, . . .	3 5 0
Stacking, leading, loading seed and straw, . .	1 17 6
Rippling, tying, and untying, ...	5 0 9
Total expense, .	£33 18 9

(Being per acre, £6, 15s. 9d.)

Of which is for cultivation and winning of crop, £16, 6s, 3d.;
(or, per acre, £3, 5s. 3d.)

Rate of Wages.—Labourers, 1s. 6d. per day.
Women, 1s. 0d. —
One pair of horses, and man, 5s. 0d. —

It has been objected by practical farmers that the wages here named are too low, and the cost of ploughing and subsoiling understated. I can only say that the wages are those which were actually paid; and with oats at 16s. per quarter, and hay at 6d. per stone of 22 lb., (the ruling prices at the period during which the operations in 1850 were in progress,) 5s. a-day for a pair of horses and a man, exclusive of charge for wear and tear of implements and stock, appears to me an ample valuation. At any rate, the same tariff is applied to the comparative expenditure on the oat crop, stated hereafter, in respect of horses and labourers. Of course, the reapers have extra wages.

Produce of Flax per Acre—1850.

Flax, 6 cwt. 3 qrs. 14 lb., at 46s. per cwt., ...		£15 16 3
Tow, 1 cwt. 1 qr. 14 lb., at 13s. do., ...		0 17 10½
Sold in Newcastle for		£16 14 1½
Deduct—Conveyance by railway and delivery in Newcastle of 2 tons 11 cwt. 2 qrs. of flax straw, at 15s. per ton,	£1 18 7½	
And steeping and scutching do., at 20s. per cwt. of produce in clean flax, (viz., 6 cwt. 3 qrs. 14 lb.,)	6 17 6	
		8 16 1½
Nett value of flax and codilla per acre, . .		£7 18 0
Deduct expenses of cultivation, &c., . .		6 15 9
Balance of profit per acre, exclusive of seed, .		£1 2 3

		Brought forward,	£1 2 3
And *seed*—16 bush., at 8s. per bushel, (sold,) weighing 56½ lb. per bushel,		£6 8 0	
Chaff and green seed, 64 bushels, at 3s.,		0 16 0	
		£7 4 0	
Deduct for beetling, 10d. per bushel,	£0 13 4		
Winnowing and cleaning, 6d. do.,	0 8 0		
		1 1 4	
Nett value of seed,			6 2 8
Total nett value of crop per acre, after paying rent and all expenses, but exclusive of charge for capital invested in land and stock,			£7 4 11

1849. OATS—1850.

6th Dec.—Land ploughed.

1850.

26th Mar.—4 bushels potato oats sown to the acre, weighing 42½ lb. per bushel—harrowed in and rolled.

16th Apr.—Oats brairded.

16th June.—In ear.

22d Aug.—Reaped.

7th Sept.—Stacked.

Oct., &c.—Thrashed.

Produce per acre :—Grain, 40⅞ bushels, weighing 42 lb. per bushel.
do. 2 do. do. 37 do. do.
Straw, 2 tons, 6 cwt.

It is necessary to recall the fact that, just before harvest in 1850, a tremendous shake-wind, causing great loss to cereal crops generally, blew for two or three days. The oats in question suffered seriously, while the flax was little injured, being already in the stook. Hence an apparent discrepancy between the produce of grain and straw reported. At least one-fourth of the grain was lost.

Outlay on Oat Crop—1850.

Rent of 5 acres, tithe free, at £2,	£10 0 0
Rates, taxes, and public burdens,	0 15 0
Seed, 20 bushels, at 2s. 2d. per bushel,	2 3 4
Ploughing, Dec. 1849,	1 10 0
Sowing, harrowing, and rolling,	1 0 0
Reaping, stacking, thrashing, &c.,	5 0 5
	£20 8 9
(Or per acre, £4, 1s. 9d.)	
Of which is for cultivation and winning of crop,	7 10 5
(Or per acre, £1, 10s. 1d.)	

Produce of Oats per Acre—1850.

40⅞ bushels oats, (42 lb. per bushel,) at 2s.,	£4 0 6
2 do. light, (37 lb. per bushel,) at 1s. 6d.,	0 3 0
46 cwt. straw, at £1, 5s. per ton,	2 17 6
Nett value of oats and straw per acre,	£7 1 0
Deduct expenses of cultivation, &c.,	4 1 9
Total nett value of crop per acre, after paying rent and all expenses, but exclusive of charge for capital invested in land and stock,	£2 19 3
In 1850, therefore, flax gave a return of	7 4 11
... ... and oats ...	2 19 3
Showing a difference in favour of flax of	£4 5 8 per acre.

I have usually, after flax, taken a crop of turnips, liming the land after the flax has been removed, and sowing the turnips with 20 loads of farmyard manure, and 2½ to 3 cwt. Peruvian guano; but this year I determined to ascertain the value of assertions, frequently hazarded, relative to the noxious influence of flax on succeeding crops, unless counteracted by an unremunerative outlay in manure.

It will be observed that neither portion of land, appropriated to flax and oats respectively, received any manure in 1850; in 1851 the cropping was reversed, flax succeeding oats, and oats flax—the whole being sown with 2 cwt. Peruvian guano, and 1 cwt. nitrate of soda, to the acre. I anticipated a material accession of expense in weeding, but on neither portion was this expectation realised, as, with the exception of a few thistles, cut by three women in a day and a half upon the 10 acres, both crops were perfectly clean.

The preliminary outlay common to both may be stated thus, per acre:—

Rent and public burdens, ...		£2 15 0
Ploughing, (1850,)		0 6 0
Manure—viz. 2 cwt. guano, . . .	£1 0 0	
1 cwt. nitrate of soda, .	0 16 0	
		1 16 0
		£4 17 0

And to this must be added for flax, (5 acres:)—

1851.		
March 19.	Second ploughing, deep, but not subsoiled, . .	£1 15 0
April 4.	Sowing (broadcast) 2¾ bush. per acre—harrowing and rolling,	1 0 0
„	13¾ bush. seed, home grown, weighing 57 lb., at 8s. per bush.,	5 10 0
April 15.	Flax brairded.	
„ 18.	Gathering stones, . .	0 1 0
June 17.	Cutting thistles, . .	0 2 3
Aug. 11 to 16.	Pulling, binding, and setting up,	3 10 0
Sept. 1.	Stacking and leading, .	1 2 0
Oct. &c.	Rippling, tying, and untying,	8 11 3
„	Loading and leading seed and straw,	0 11 0
		£22 2 6
	Or per acre, . . .	4 8 6

FLAX—1851.

	Total expenditure on crop 1851, per acre,		£9 5 6
Of which is for	cultivation and winning of crop,	£3 6 6	
...	manure, . . .	1 16 0	
...	rent and public burdens,	2 15 0	
...	Seed, . . .	1 2 0	
			£9 5 6

Produce of Flax per Acre—1851.

Raw flax straw, 2 tons, 4 cwt., 0 qr., sold at £3, 10s. per ton,	£7 14 0		
Less 12s. 6d. per ton, freight by rail,	1 7 6		
Nett value of flax-straw,		£6 6 6	
Clean seed, 15 bush., weighing 56 lb., at 7s. 6d. per bush.,	£5 12 6		
Less beetling and cleaning, at 1s. per bush.,	0 15 0		
		4 17 6	
Chaff and green seed, 90 bush., at 3d. per bush.,		1 2 6	
Total produce of crop per acre,		£12 6 6	
Deduct expenditure,		9 5 6	
Total nett profit per acre,		£3 1 0	

I would observe here, that the effect of the guano and nitrate of soda upon the flax crop of 1851 was imperceptible; and I believe it to have been a superfluous and unremunerative expenditure, to the extent of £1, 16s. per acre. The extra cost incurred in rippling and tying in 1851, compared with 1850, arises from the extreme care which I found to be necessary in the preparation of the straw for market, in order to satisfy the requirements of purchasers, who complained of serious depreciation in the fibre, in consequence of inattention on the part of growers in separating the seed, and tying up the sheaves.

Oats—1851.

Outlay on Oat Crop, 1851—(5 *Acres*.)

March 18.	Sowing 5 bush. common oats per acre, harrowing and rolling,	£0 18 6	
"	25 bush. seed, at 2s. 4d. per bush., weighing 40 lb. per bush.,	2 18 4	
April 16.	Oats brairded.		
June 17.	Cutting thistles,	0 2 3	
Aug. 30, &c.	Reaping and stacking,	4 16 3	
Oct. &c.	Thrashing, cleaning, &c.,	3 15 11	
		£12 11 3	
	Or per acre,		£2 10 3
	Add expense common to both crops,		4 17 0
	Total expenditure on oat crop per acre, 1851,		£7 7 3

Produce of Oats, 1851—*per Acre*.

67⅘ bush. oats, weighing 40½ lb., at 2s. 6d. per bush.,	£8 9 2
3 bush. light, at 1s. 6d. per bush., weighing 36 lb. per bush.,	0 4 6
48 cwt. straw, at £1, 5s. per ton,	3 0 0
Total produce of crop per acre,	£11 13 8
Deduct expenditure, do.,	7 7 3
Total nett profit per acre,	£4 6 5
In 1851, therefore, oats gave a return of	£4 6 5
... ... and flax ...	3 1 0
Shewing a difference in favour of oats of	£1 5 5 per acre.

Between the 19th August and 2d September, in 1851, the 5 acres occupied by flax were ploughed, harrowed, sown with white mustard, (½ bushel to the acre, at 6s. per bushel,) harrowed in with 1 cwt. guano, and rolled. On the 23d October, sheep were put upon 3 acres of this, being about 6 to 8 inches high, the other 2 acres succeeding.

The 5 acres occupied by oats were ploughed on 17th September, and likewise sown with white mustard; but though the plant is not generally very liable to injury by frost, the severe weather experienced in the early part of the past winter has prevented its growth materially, and at no time has there been a good bite for sheep upon it.

The 10 acres will be limed for turnips in March.

I have endeavoured to confine my narrative to the particulars required by the Society, in illustration of the comparative value of flax and other crops; and before proceeding to any remarks upon the various stages of cultivation, and the peculiar management of the former, I would observe, that in this country we may discard altogether any consideration of certain processes, formerly indispensable to the remunerative growth of flax. The tedious, intricate, and hazardous operations of "steeping," "draining," and "grassing," incompatible with the multifarious business of his farm, which demands the attention of the agriculturist here, have been entirely superseded by the system of steeping introduced in Ireland by M. Schenck, and now adopted by Messrs Clarke, Plummer, & Co. of Newcastle, and Mr Fergus of Prinlaws, Kirkaldy; while the ulterior preparation of the fibre, (more or less conducted by manual labour, and therefore not unsuited, in the absence of remunerative employment, to the rural population of Ireland, but which, speaking generally, could not in Great Britain profitably become incorporated with the routine labours of the farm,) I mean by "bruising" and "scutching," is likewise more economically perfected by machinery, and on a larger scale.

It is true that the farmer *might* attach steeping-vats and scutching-mills to his steam-engine, and thus manufacture his own lint and codilla for the market, saving possibly a fractional part of the cost, now directly or indirectly borne by him in the preparation of the fibre, and undoubtedly retaining many of those properties which are lost in the steep-water and shove. [illegible]

These, however, after all, are the least important ingredients in the composition of the flax-plant, viewed in relation to their value, as restoratives of fertility abstracted by it; and practically, the ready disposal of their flax-straw, with little trouble, and at a fair profit, would, by 99 per cent of farmers, be preferred to competition with manufacturers in a field, where experience, and capability, and means, are entirely with the latter.

The great drawback to the profitable export of raw straw is of

course its *bulk*, combined with the distance of a market, varying with the locality of the producer. In my own case the freight by railway, a distance (as the crow flies) of about 60 miles, imposes a loss of no less than from 27s. 6d. to 35s. per acre, and it cannot be doubted that, if flax were generally grown, the erection of steeping and scutching mills at convenient intervals, either by manufacturers, or by subscription of agriculturalists themselves, would follow. In the mean time, however, even the heavy expenditure attendant upon export of the straw fails to render the crop unremunerative, as compared with other crops in ordinary cultivation; and every diminution of this item of expense enhances the value of flax in the comparison.

On the other hand, the new system of steeping enables us to ripen the seed with certainty, and infinite advantage over the mode usually adopted in former times, and, *of itself*, sufficient to justify the antipathy of landowners and farmers to the growth of flax. It is no longer *expedient* to strip off the seed from the plant in its green state; nor is there any inducement, in order to improve the quality of the seed, to allow the plant to grow beyond the time when it is fit for pulling—thus at once unnecessarily impoverishing the soil and deteriorating the quality of fibre. On the contrary, the plant may now be pulled solely with reference to its perfection of fibre; while, after it has been removed from the soil, the seed still continues to draw nutriment from the stalk, and fills, and swells, and ripens in the stook.

My remarks have been directed solely to the opening created for the culture of flax by the recent improvement in the mode of steeping, and consequent facility for disposal of the straw;—not that I undervalue or discredit the possible results of inventions by M. Claussen and others, whereby flax is manufactured, as well alone, as in combination with wool, silk, and cotton, without the partial decomposition of its texture by means of fermentation; but I am not personally aware that a market exists, from these sources, for the purchase and sale of raw flax-straw; and though it is obvious that their success would at the same time increase the consumption and improve the price of flax, it is safer to found our calculation upon means and demand, whereon we may rely for a return for our produce.

It will be seen that, in the statement of profit, (1851,) the disposal of the flax-straw in its raw state, at a fixed price per ton, supersedes the process whereby the nett value of the straw was arrived at in 1850.

Messrs Clarke, Plummer, & Co., (whose extensive business as flax-spinners, combined with the facilities recently acquired by them of steeping and scutching, on their premises in Newcastle, a large annual supply of flax straw, would enable them to consume the produce of many more acres than are at present sown within

a limited circuit,) have this year made arrangements, whereby, partly by previous inspection of the growing crop and partly by sample after it has been won and rippled, they readily assign a fair value to the raw straw, to be delivered in Newcastle-on-Tyne; the seller receiving the price of his produce one-third in ten days after delivery, and the other two-thirds at intervals of three months.

A similar proposition was intimated on the part of Messrs R. M. Craig & Co., of Prestonholm, Dalkeith, at the close of the year 1850, stating their intention, provided they had an assurance that a certain quantity of land would be devoted to the culture of flax for two or three years ensuing, to erect the requisite machinery for steeping and scutching on the best principle, and to such an extent as the wants of the district seemed to require. This offer has not hitherto been met by landowners and farmers in such a manner as to justify Messrs Craig & Co. in fulfilling their conditional pledge. The proposal, however, on their part, proves that an increased production of native flax would be met by increased facility of its vend, while the enormous consumption of the article itself, apparently limited only by the supply, forbids any restraint upon free competition among manufacturers.

I do not understand our present inquiry to include any minute investigation of the theory, that flax scourges and exhausts the land in comparison with other crops; and still less do I propose to enter upon the discussion of the various modes in which the seed may be prepared, or the relative advantage to be derived from its use, in feeding stock; but I will conclude this paper by a simple summary of the different stages of cultivation, with such remarks as occur to me to be likely to promote the successful operations of my readers.

1. *Soil.*—The soil best adapted to flax is a strong deep loam, with clay subsoil; but almost any soil of medium quality will bear a good crop, if properly prepared: the exceptions are heavy clay, gravel, sand, and peat.

2. *State of land.*—The land should be in good heart, but not recently manured, (at least with any substance that will not readily become disintegrated by tillage,) as otherwise the crop will be uneven; neither must it be too rich, as the flax is thereby rendered too luxuriant, and liable to lodgment before it is fit for pulling. If very poor, it might not be unadvisable to top-dress, before or at the time of sowing, with guano or liquid manure, either of which would be safer than solid manure, as regards their effect on the equality of crop, and their freedom from the seeds of weeds.

In Belgium, it is not unfrequent to apply rape and other cake, dissolved in urine, at the rate of 1000 lb. of cake to 2000 gallons per acre, ten days or a fortnight before sowing. The land should

be thorough-drained, laid flat, and should *not* have been limed within three years of the flax crop. I am aware that exceptions exist to the universality of the maxim regarding lime; for instance, at Kilfinane, in the county of Limerick, a good crop was one year obtained by Misses Gascoigne, although the land had been thus dressed; but I am inclined to think that some special circumstance or condition of the soil must in such cases attend success.

3. *Rotation.*—The variety of "courses" in which flax has been proposed to be grown, is sufficient evidence that there is some difficulty in selecting that which is best. On the whole, I believe after lea, or after a grain crop succeeding lea, to be its most suitable place in the rotation.

It ought not to follow potatoes, (though constantly thus in Ireland, on account of the poverty of every other break,) turnips, or any root crop which has been highly manured, otherwise the straw will be rank, coarse, and unequal; and, without further experience, I would deprecate its recurrence on the same ground at intervals of less than eight to ten years. At the same time, this precaution is founded as much from observation of the effects of the crop repeated *much more* frequently than once in eight years, as from the opinions of others on the point. It should be followed by turnips, if succeeding a grain crop; or, if after lea, by wheat, oats, or barley; but in either case a stolen crop of white mustard, to be eaten off by sheep, may intervene. Some sow grass seeds along with flax, and undoubtedly the general result is a good take of clover; but, on the other hand, the flax straw becomes discoloured at the root, and is hindered in drying—two evils sufficient to discountenance the practice.

4. *Preparation of the land.*—The main object to be attained is deep cultivation and a fine tilth, perfect pulverisation of the soil to a considerable depth, and freedom from weeds. The roots of flax will accommodate themselves to the state of tillage, and the straw will be in proportionate height to the depth of the root.

The land should be ploughed early in the autumn and laid flat, again ploughed and subsoiled in the spring, and ploughed again if necessary; rolled and harrowed to eradicate all weeds, and reduce the surface to a level.

5. *Seed.*—The seed should be smooth, bright—*rather*, but not *very* plump—of a brownish-red colour, sweet to the taste, and weighing from 52 to 56 lb. per bushel. That usually sown is imported from Riga or Holland—especially the former, if the land be light. English seed, however, raised from Riga seed imported the previous year, is much to be preferred, being cheaper and cleaner, and producing fibre of better quality, than either Dutch or Russian.

My own practice is to sow as much Riga seed in each year as

will suffice for the succeeding *flax* crop; but home-grown seed may be, without fear, continued another season.

From Riga it is imported in barrels containing 3½ bushels, branded as "sowing seed," to distinguish it from "rejected sowing seed" and "crushing seed." The price is 10s. to 12s. per bushel in this country. It is, however, always exceedingly dirty, containing 2 quarts and upwards of rape, camalina sativa, and other seeds, in the barrel. These should be carefully sifted through perforated zinc, with *round* holes, (twelve to the inch.) This answers much better than the wire-gauze in common use, as the squares in the latter are too contracted for the passage of the refuse seeds, whenever their diagonal section is small enough to retain linseed. Dutch seed is imported in old wine-hogsheads containing 7 bushels, but is less to be depended upon than that from Riga. It is, however, more suited to a clay soil than the latter, and costs in this country 11s. or 12s. per bushel.

I have also grown from Sicilian seed flax of good quality, and a considerable quantity is imported from America. The latter, however, is much infested with the seed of the inveterate "flax-dodder," to which the weeds noticed above are harmless in comparison;—the latter merely disfigure the crop, and increase the trouble of weeding—the "dodder" chokes and destroys the flax plant, and, once sown, defies all efforts at eradication during the season.

6. *Time of sowing.*—As early in April as the land can be got into order, and the weather suit—that is to say, in the absence of frost or much wet. If the soil be well prepared, and the land in good condition, the seed will not suffer from drought; but in ill-prepared ground it will not spring without rain; on the other hand, in damp land, it will come up unevenly.

7. *Quantity of seed.*—For *flax* crop, from 2¾ to 3½ bushels per imperial acre may be sown, according to the quality of fibre desired. When an average quantity of seed, and an average quality of fibre are expected, 2¾ bushels will, in most soils, answer the purpose; and the quantity and quality of seed and fibre will vary inversely in proportion to a greater or less amount of seed sown.

For *flax* crop, the seed should invariably be sown *broadcast*, as uniformly as possible; much afterwards depends upon the equality and evenness of the straw, both in height and strength; and hence the objection to ridge-and-furrow, which tend to uneven sowing, uncertain growth, and unequal pulling.

For future seed, it is matter of little consequence whether we sow broadcast or in drills, as the object is to obtain a multitude of well-filled capsules at the expense of the quality of fibre; but unless the land be excessively dirty (in which case flax ought not to be sown at all) I see no advantage in the latter mode. The quantity used should be from 1¼ to 1½ bushels per acre.

8. *Weeding.*—When the plant is about three inches in height, and as often afterwards as necessary, the weeds should be hand-picked. In Belgium this is done by women and children, who creep upon all-fours, with coarse clothes round their knees, to prevent injury to the plants. I have rarely found weeding more than once in a season requisite; and if a dry, breezy day be selected, and the workers (divested of their shoes) face the wind, the plant will speedily recover from the pressure of their feet. Probably in successive weedings more care would be required; but if the weather be at all favourable, few weeds but thistles can rival the rapid growth of flax, which outstrips and smothers all else.

9. *Pulling.*—If any part of the crop be much laid, this should be first pulled, even though not fully ready; and if, unfortunately, from bad sowing, or difference in soil, or any other cause, *portions* of the crop are deficient in length, these should be pulled, and kept apart from the main crop. As soon as one-half, or rather more than one-half, the stem turns yellow, and the leaves fade, and when the fluid in the boll becomes consistent, pulling may safely commence—that which is grown for seed being allowed to stand till the last. In no case must flax be pulled during wet weather.

In pulling, care should be taken to leave any thistles or other weeds which may have grown with the flax, and to keep the handfuls *even* at the root end. These are laid upon a band, formed of two lengths of flax, five or six stalks in each, and a binder ties up the sheaves, which are placed then in small stooks to dry. The sheaves should be rather loosely tied, two-thirds of the length from the root ends, which being spread out, assist the process of drying, at the same time that they defend the stook from being blown over. If this, however, should occur, they ought not to be allowed to lie, as the colour of the fibre will thus be tarnished, and the worms are apt to draw the branches of the plant under ground, and thus defile the straw and seed.

Bands of straw and rushes, and hemp string, are also employed for tying the sheaves; but the flax bands are most easily obtained, and sustain little damage in the usage. It is also customary to set up the flax in "wind-rows," and afterwards in narrow "wind stacks," before storing or stacking it in bulk; but the ordinary plan adopted with grain crops perfectly answers the purpose, is more easily understood by labourers, and takes less time and trouble than the above, and hence deserves, I think, the preference. Two binders and ten pullers should pull and stook an acre in ten hours.

10. *Stacking.*—In two or three weeks, or longer, according to the weather, when the sheaves are entirely free from damp, inside and out, and the seed has become brown and dry, the crop may

be stacked. Logs of wood, and thorns or brambles, should be placed at the bottom, and the stack erected in an oblong square, in such a direction as to catch the prevailing wind on the narrow side of the parallelogram, the roots being laid at the outsides, and each quality of flax, if more than one, carefully distinguished. The stack must be thatched, and examined daily, to insure the discovery of heat, if the flax should "come" again. If heat occur either in stook or stack, they must be taken down, and the sheaves spread out, otherwise the fibre will be irreparably injured. With ordinary care, however, and without extraordinary bad weather, this cannot happen; and in ten days the crop may be considered out of danger, and remain till opportunity arises for separating the seed from the straw. It may be well, however, to examine the stack occasionally, in case it should become infested with mice, which are more destructive to flax than rats.

I have seen much dirt created by these vermin, and much seed destroyed by a small maggot, apparently originating in the fæces and refuse of their nests.

11. *Separation of seed from the straw.*—Various methods are employed to separate the seed from the straw. It was formerly rippled in the green state, (when the straw had to be steeped in ponds,) and the bolls dried on shelves, or on the barn floor, or on a cloth in the open air. This, of course, is no longer likely to be adopted. The seed is also sometimes thrashed with a flail, the sheaves remaining tied; but the effect is to entangle the stalks, and to leave a good deal of chaff and seed in the sheaf, thus rendering the straw less marketable, and wasting the seed. Thirdly, the seed is beetled with mallets, while still upon the straw, whereby thrashing and crushing the boll are accomplished at one operation, and the seed merely requires to be put through a winnowing machine to fit it for use. But even this plan, though superior to those already mentioned, leaves the stems encumbered with chaff and green seed, and ravelled in the sheaf, so as to diminish its value to the purchaser. The safest and best way to insure the production of a sample which will bring its full worth, is to ripple off the seed in nearly the same manner as was formerly practised with the newly-pulled plant—great care being taken to use no unnecessary violence, to the risk of breaking the ends of the stalks when the bolls are stripped off.

A rippling-comb costs 15s., and consists of a row of iron teeth, 18 inches long, half an inch square, screwed into a metal plate, which is bolted upon a bench 8½ feet long. The teeth are a quarter of an inch apart at the bottom, and gradually taper upwards till the distance between them is half an inch near the top, whence they are sharpened to a point.

Two men sit upon the bench, one at each end, facing each

other, alternately drawing handfuls of flax, (brought to them by women, whose business is to untie the sheaves as carefully as possible,) spread out like a fan, briskly through the rippling-comb once or twice, as may be necessary. The bench is placed on a barn-cloth, to catch the bolls as they are stripped off, and the straw is again carefully tied into bunches or "beats," and carried away. Two men will ripple from 12 to 18 cwt. of straw in ten hours.

12. *Beetling.*—The extraction of the seed from the boll is then obtained either by "beetling" with mallets, as before mentioned, or (which is much quicker and better) by passing the bolls between two smooth metal rollers, set so as to crush the bolls without injury to the seed, after which a common winnowing machine readily separates the latter from the chaff. The same rollers, set more closely together, are used for crushing the seed previous to boiling it for food.

We have now gone through the various processes whereby the seed and fibre are prepared for home use or for market, and the chaff and green seed remain for mixing with other ingredients for the use of stock.

Locality and other circumstances will alter in some degree the results detailed in the foregoing narrative, but it is hoped that this has been sufficiently explicit, to enable the practical farmer to judge, whether, in his own case, the culture of flax upon a larger or smaller scale be worthy of experiment.

II.—By James Farquharson, Esq., Craig House, Kincardineshire.

[Premium—The Gold Medal.]

The two small farms* to which the following report refers, extend together to 160 acres, are situated close to the Grampian range of mountains, and are separated from each other by a stream, which takes its rise amongst the hills about three miles north-west of the centre of the farms. The altitude above the level of the sea varies from 290 to 350 feet; and although situated ten miles inland, the harvest is frequently not more than from six to ten days later than on the sea coast. The exposure is south and south-eastern; and the climate is peculiarly salubrious, being dry, with rather a high but equable temperature.

Besides being intersected by a stream of water, one of the farms is bounded on the north-east by a burn or rivulet. On the higher grounds the soil is composed of a brown light loam, resting on a gravelly subsoil, and quite dry. The haugh-lands, situated on the banks of the streams already referred to, are composed of alluvial deposits, occasionally interspersed with patches of gravel.

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* Mill of Galloquhine and West Galloquhine belong, the former to the Right Hon. the Earl of Kintore, and the latter to Major Andrew Gammell of Drumtochty.

The rotation of cropping followed is termed the six-shift, and is as follows, viz.:—

1st year, Oats, after three-year-old lea.
2d ditto, Turnips, potatoes, and flax.
3d ditto, Wheat, barley, bere or oats, and sown down with grass seeds.
4th ditto, Grass cut for horses, soiling cattle, and hay.
5th ditto, Pastured with cattle.
6th ditto, Ditto, ditto.

Occasionally the new or first year's grass is pastured, and then cut the second year: this is done principally with the view of procuring good perennial rye-grass seed.

My attention was first directed to the growing of flax in 1843, and since then, with few exceptions, I have had annually a few acres under cultivation; but the notes which I find in my farm-book, regarding the various experiments and processes connected with my flax crops, are somewhat imperfect, with the exception of crop 1849, to which this report more particularly refers.

It, however, having of late years become important to the agriculturist in this country to obtain every possible information relative to flax-growing, I shall state shortly, but as distinctly as I can, my own practical experience in the matter, and at the same time endeavour to convey whatever information I may have obtained elsewhere.

FLAX CROP—1843.

Extent.—1 acre 2 roods 20 poles.
Soil.—Deep alluvial, or haugh-land.
Preparation for sowing.—Oats 1842. Stubble turned over in autumn; cross-ploughed in spring; harrowed and weeds collected; deep ploughed, harrowed, and weeds again collected, farther on in the season; rolled, and again ploughed—light furrow; again harrowed and rolled; gave no manure.

Sowing, Weeding, and Pulling.

May 12. Riga seed, 7 bushels—cost £2, 11; covered in about an inch deep with garden rakes, and rolled with hand-roller.
May 19. Fine equal braird, and very thick.
June 9. Weeding—most approved method, women and girls crawling along on all fours, with baskets, always facing the wind, so that the plants laid flat may be again assisted to an upright position.
Aug. 26. Two-thirds pulled—being 106 days from sowing to pulling.
Aug. 28. Remaining third pulled.

Watering and Grassing.

Aug. 26. Two-thirds steeped.
Sept. 6. Taken out of pond—having been 11 days in retting—and spread on grass field.
Oct. 2. Taken off grass—having been 26 days in bleaching.
Sept. 6. Remaining third steeped.
Sept. 22. Taken out of water, and spread on grass field—having been 16 days in retting.
Dec. 1. Taken off grass—having been 60 days in bleaching.

With the view of obtaining a fine quality of flax, the seed was not allowed to come to maturity. The reason of the whole crop not having been put into the water at the same time, was in con-

sequence of the pond having been made too small; and the result of such mistake was, that while two-thirds of the flax first steeped turned out very fair in quality and moderately productive in quantity, the remaining third, by mismanagement and want of experience, was almost wholly lost. The value of the entire produce in clean flax and codilla was £15, 12s. 6d.; while with proper management it would have been upwards of £20.

Immediately after the flax was pulled, the land was ploughed, harrowed, and weeds collected, and the manure—24 tons well-made farmyard dung—which would have been applied to a turnip or other green crop the preceding spring, was now given, along with 20 bolls of lime; and on the 13th September, 16 days after the flax was pulled, I had the ground sown with 6 bushels of wheat. Grass seeds were sown and harrowed in on 8th April 1844; on the 29th June following, the wheat was full in ear; and on the 9th September I reaped an abundant crop, with the young grasses clean and looking well.

FLAX CROP—1844.

Extent.—2 acres 2 roods 30 poles.
Soil.—Deep alluvial, or haugh-land.
Preparation for sowing.—Oats 1843. Ploughing and all other operations exactly the same as those for the flax crop of the previous year.

Sowing, &c.

May 9. 10 bushels Riga seed.
May 23. Weeding.
Aug. 30. Pulled—113 days on ground.
Aug. 31. Steeped.
Sept. 18. Taken out of water, and spread on grass field—having been 18 days in retting.
Oct. 2. Taken off grass—having been 14 days in bleaching.

This was a very fair crop, and pretty well managed up to the rolling and scutching operations; but in these there was evidently a want both of improved machinery and skill in handling the flax. The following statement will show the additional cost of this flax crop, compared with that of one of turnips, and the relative value of the produce:—

Ploughing, and all other operations connected with the cleaning of the land, up to the time of sowing, being the same as for a turnip crop, no charge falls to be stated,		£0 0 0
10 bushels Riga linseed,	£4 0 0	
Less value of turnip seed for 2 acres, 2 roods, 30 poles,	0 5 6	
		3 14 6
Extra labour in sowing, raking in, and hand-rolling, beyond that of a turnip crop,		0 5 0
Expense of weeding, same as hoeing, &c., of turnips,		0 0 0
Pulling—24 women 1 day, at 8d. each,		0 16 0
Carrying and putting into pond—6 men and 4 horses 1 day,		1 0 0
Taking out of water and spreading on grass,		1 2 6
Taking off grass, and stacking,		0 19 0
Scutching—15 cwt. flax, at 10s. per cwt.,		7 10 0
Extra cost of flax crop,		£15 7 0

Brought forward, .		£15 7 0

PRODUCE.

15 cwt. of clean flax, at 40s. per cwt., . .	£30 0 0	
1 cwt. 14 lb. of fine codilla, at 20s. per cwt., .	1 2 6	
4 cwt. of coarse ditto, at 2s. 6d. per cwt., . .	0 10 0	
		31 12 6
Leaving		£16 5 6
to meet rent and expenses of ploughing, &c.; and the ordinary value of turnips in this part of the country being from £3 to £4 per acre, when consumed on the farm, take the highest of these rates—say 2 acres 2 roods 30 poles, at £4 per acre, amounts to		10 15 0
Leaving		£5 10 6

in favour of a flax compared with that of a turnip crop; and had the seed of the flax been saved, the difference would have been increased to £15, or £5, 11s. 7½d. per acre, while at the same time manure would have been produced, by feeding cattle with the seed and chaff, equivalent, or nearly so, to that from a turnip crop.

After the flax was pulled and removed from the ground, the system followed last autumn was again pursued, and with equal success. The manure which would have gone to the turnip crop the previous spring was now applied, together with a quantity of lime; and within seven days from the time the flax was pulled, the same small field was sown with wheat. On the 7th April following the grass seeds were sown and harrowed in, on 12th July the wheat was full in ear, and on 23d September it was cut down, and turned out an excellent crop.

1845.

Had no flax sown this season.

FLAX CROP—1846.

Extent.—2 acres 10 poles.
Soil.—Light loam, with gravelly subsoil, incumbent on strata of red sandstone.
Preparation.—Oats 1845. Ground prepared as in former years.

Sowing, &c.

May 16. 4½ bushels of old Riga seed cost 32s., and 1 bushel new Dutch seed cost 15s.
July 2. Partly in bloom, and from 12 to 18 inches in length in 47 days from date of sowing.
July 11. Full in bloom, and very beautiful—56 days.
Aug. 24. Pulled, having been only *three months and eight days* from time of sowing until the date of pulling.

The seed was allowed to ripen, and, when rippled and cleaned, weighed 54½ lb. per bushel, and sold for 57s. 6d. per quarter. The flax was only retted the following summer, and the amount and value of the produce turned out similar to crop 1844.

FLAX CROP—1847.

Extent.—3 acres 19 poles.
Soil.—Almost none—subsoil a poor, hungry, red clay, nearly as hard as rock.
Preparation.—Ploughed from the *heather*, on the side of the Grampians, in 1846, and sown with oats. Poor crop of corn; and being close to an extensive game cover, what was of it was devoured by hares and rabbits.

Sowing, &c.

May 14. 3 bushels Riga seed, and 3 bushels of my own, being part of the seed saved from last year's crop.
July 10. Not looking well.
Aug. 25. Pulled and rippled.

This crop turned out much better than anticipated from appearances in the month of July, and, to a certain extent, proves that the flax plant will grow almost in any soil, or, as in the present instance, almost without a soil at all. My motive for sowing flax in such a situation, and on such a piece of ground, was, that if it did not grow I would not lose much, having given no manure, and, if it did grow, I was sure that the crop (flax) would not be eaten up by vermin; while, on the other hand, I was well aware that, although I had manured the land, and succeeded in getting a crop of turnips, I would have had little trouble in carrying them home.

The value of the seed, bolls, and flax, amounted to £13, 9s. 4d.

After an autumn and a spring ploughing, but without giving any manure, I had this piece of reclaimed moor sown, on the 5th of April 1848, with rye and grass seeds, and reaped but an indifferent crop on the 8th September following.

FLAX CROP—1848.

Extent.—1 acre 3 roods 11 poles.
Soil.—Low lying, deep, alluvial haugh-land.
Preparation.—Operations similar to former years.

Sowing, &c.

May 6. 3½ bushels fine Riga sowing seed.
July 26. In bloom, and partly beginning to boll.
Aug. 28. Pulled—3 months and 22 days from date of sowing.

The cold, wet, ungenial weather during the latter end of June, and nearly the whole of the month of July, prevented the flax being weeded until too far advanced in the season, and consequently the work was not only ill performed, but the plant was slightly injured by being trampled upon when too long.

The several processes of pulling, rippling, retting, bleaching, and milling, were all gone about as in previous years; but having consumed both seed and chaff in the feeding of my own cattle, an exact account was not kept, and I cannot, therefore, state the value of this flax crop. I may, however, observe that, adjoining the flax on the same field were several acres of swedish turnips, and that the flax land, after being thoroughly cleaned the following spring, but without being manured, except a dressing of lime from a gas-work, was sown, on the 12th of May, with Chester

bere and grass seeds, and that an equal quantity of the turnip land was also sown down at the same time, and with the same kind of seeds; and, farther, that from the date of sowing until the time of reaping, no perceptible difference whatever was observable between the crop on the flax land and that after the swedish turnips—the produce in grain of both divisions being, as near as may be, the same.

Flax and Potato Crops—1849.

The field to which the following remarks more particularly refer measures 12½ acres, is a light loam, with gravelly subsoil, incumbent on the red sandstone formation, quite dry, and what in the district is generally termed a sharp early soil. The crop on this field in 1848 was oats after lea; and in 1849, 5 acres were planted with potatoes, 5 acres sown with flax, and the remaining 2½ acres with swedish turnips.

I may remark that, in growing flax, I have always considered it as a green crop, and treated it as such, with this difference, that in place of giving the usual manure allowed for a turnip or potato crop, I preferred reserving it for the wheat or barley crops the following season; and so little do I approve of manuring flax, that had it not been expressly desired that each portion of the field on which the experiment was to be made should be treated exactly alike, I certainly would rather have followed the system I had adopted in former years. After properly cleaning the land, and reducing it to a fine mould, I never once failed in quickly getting a strong healthy plant; and although a quantity of good manure might still have made it stronger, it would at the same time have tended very much to encourage the growth of weeds, the small seeds of which it is difficult wholly to get rid of. If flax was sown in drills the same as turnips, the case would then be different, as the weeds could be kept down in the usual way, by repeated hand and horse hoeing; but, with a broadcast flax crop, one weeding is all that can be got done;—and if the weather should happen to be wet, even that one weeding may not be overtaken in time.

Another reason I have for not giving manure to the flax crop is, that immediately after the flax is pulled the ground requires to be stirred with the plough and harrowed, the broken-down flax and weeds collected and removed from the field; and in these operations it is impossible to avoid exposing to the atmosphere part of the unexhausted manures. The dates of the several ploughings and other operations connected with the flax and potato crops, as well as the cost of production, the relative value of produce, and the nett profit derived from each of the five-acre divisions, will be found minutely detailed in the following statements.

FLAX.

No. I.—Statement of Rent, Cost of Cultivation, and Value of Produce of Five Acres of Flax, 1849.

1849.	*Dr.*	
Jan. 1.	Rent of land, £1, 10s. per acre, ...	£7 10 0
3.	Ploughing from stubble, 7s. per acre, . . .	1 15 0
Mar. 19.	Cross ploughing, 7s. per acre, ...	1 15 0
23.	Harrowing, weeds collecting, and carting off from field, 5s. per acre, ...	1 5 0
Apr. 27.	Deep ploughing, 7s. per acre, ...	1 15 0
30.	Harrowing, weeds collecting, and carting off from field, 4s. per acre, ...	1 0 0
May 8.	84 loads good well made farmyard manure, weighing 17 cwt. 14 lb. each load = to 71 tons 18 cwt. 2 qr., (or full 14 tons per acre,) which at 4s. per ton, amounts to £14, 7s. 8d., and of this sum one-third falls to be charged against the present crop, ...	4 15 10
„	Carting manure and spreading on surface, 3s. 6d. per acre,	0 17 6
„	Ploughing down manure, 7s. per acre, . . .	1 15 0
9.	Smoothing with garden rakes, and again collecting weeds, .	0 8 0
10.	12 bushels Riga linseed, 56 lb. per bushel, at 7s. 6d. per bushel,	4 10 0
„	Sowing, covering in with garden rakes, and hand-rolling, .	0 12 0
June 30.	Weeding, 4½ days of 9 women, at 8d. per day each, £1, 7s., and 1 man 4½ days, at 2s. per day, 9s., ...	1 16 0
Sept. 3.	Pulling, 5 women and 1 man 4 days each, . . .	1 1 4
8.	Binding and stooking, 5 women and 1 man, 2 days, .	0 10 8
28.	Carting to mill barn, and thrashing, . . .	1 9 4
„	Stacking and thatching, ...	0 12 6
1850.		
July 17.	Watering and grassing, ...	4 10 0
„	Carting to watering pond fifteen miles, and a like distance of the flax home from scutching mill, ...	1 5 0
1851.		
Mar. 29.	Milling 20 cwt. 0 qrs. 21 lb. of flax, at 10s. per cwt., .	10 1 10
	Total cost, .	£49 5 0

1849.	*Cr.*	Produce.	
Nov. 3.	Flax bolls, after being bruised, 117 bushels, at 9d. per bushel, ...	£4 7 9	
„	41¾ bushels seed, at 7s. per bushel, . .	14 12 3	
1851.			
Apr. 15.	20 cwt. 0 qrs. 21 lb. clean flax, at 48s. per cwt.,	48 9 0	
„	1 cwt. 3 qrs. 22 lb. fine codilla, at 18s., .	1 15 1	
„	11 cwt. 2 qrs. 24 lb. coarse codilla, at 3s., .	1 15 2	
			70 19 3
	Nett profit, .		£21 14 3

Or at the rate of £4, 6s. 10d. per acre.

POTATOES.

No II.—Statement of Rent, Cost of Cultivation, and Value of Produce of Five Acres of Potatoes, 1849.

1849.	*Dr.*			
Jan. 1.	Rent of land, £1, 10s. per acre,	£7	10	0
3.	Ploughing from stubble, 7s. per acre,	1	15	0
Mar. 19.	Cross-ploughing, 7s. per acre,	1	15	0
23.	Harrowing, weeds collecting, and carting off from field, 5s. per acre,	1	5	0
Apr. 27.	Deep-ploughing, 7s. per acre,	1	15	0
30.	Harrowing, weeds collecting, and carting off from field, 4s. per acre,	1	0	0
May 1.	Opening drills, 5s. per acre,	1	5	0
3.	84 loads good well made farmyard manure, weighing 17 cwt. 14 lb. each load = to 71 tons 18 cwt. 2 qrs., (or full fourteen tons per acre,) which at 4s. per ton, amounts to £14, 7s. 8d.—and of this sum, one-third falls to be charged against the present crop,	4	15	10
May 3.	Carting manure and spreading in drills, 3s. 6d. per acre,	0	17	6
„	3 tons 15 cwt. seed potatoes, Irish cups, at 80s. per ton,	15	0	0
„	Picking and cutting, large sets, 2s. per acre,	0	10	0
„	Planting, 2s. per acre,	0	10	0
„	Closing drills, 5s. per acre,	1	5	0
June 21.	Horse-hoeing, 2s. per acre,	0	10	0
22.	Hand-hoeing, 3s. 3d. per acre,	0	16	3
23.	Earthing up drills with plough, 2s. per acre,	0	10	0
July 8.	Horse-hoeing, 2s. per acre,	0	10	0
10.	Hand-hoeing, 2s. 3d. per acre,	0	11	3
14.	Earthing up drills with plough, 3s. 6d. per acre,	0	17	6
Oct. 13.	Taking up and storing on the field in long narrow bins, and covering with earth, 11s. 6d. per acre,	2	17	6
1850.				
April 8.	Taking out of bins, picking for market, and delivering, 21 tons 7 cwt. 3 qrs., at 2s. 1d. per ton,	2	4	6
	Total cost,	£48	0	4

1850.	*Cr.*	Produce.					
April 8.	21 tons 7 cwt. 3 qrs. potatoes, full market size, at 52s. per ton,	£55	12	2			
„	4 tons 9 cwt. 2 qrs., undersized potatoes, at 36s. per ton,	8	1	1			
					63	13	3
	Nett profit,				£15	12	11

Or at the rate of £3, 2s. 7d. per acre.

It has already been incidentally observed that the flax plant will grow almost in any soil; at the same time, it is well known that a deep, moderately rich loam, with a porous subsoil, not wet, but inclined to damp, is the most suitable. The field to which the details in the preceding tables refer, would, at one period, and when flax was cultivated to a greater extent in the locality than now, have been considered altogether unsuitable; but although the crop was by no means a heavy one, still it was moderately good;

and had the value been contrasted with that of a turnip in place of a potato crop, or with the value of a potato crop previous to the great failure of that root in 1846, the result would have been widely different. Instead of 52s. per ton, the current rate for potatoes then ranged from 24s. to 40s. per ton, the latter price being considered much more remunerative than the growing of turnips.

Against the flax there is also the charge of carrying the straw a distance of fifteen miles for the purpose of being watered, and of bringing back the clean flax and codilla a like distance of fifteen miles from the scutching-mill. Farther, in looking at the relative value of the produce, the great risk now attending the growing of potatoes, compared with flax, must be kept in view; and, should the risk happily decrease, or cease altogether, then the value of that esculent will, as a natural consequence, become depreciated. Had the potatoes, in place of 52s., only sold for 32s. per ton—that being a very common rate in this part of the country previous to 1846—then, in place of a profit on that crop, there would actually have been a very considerable loss. But, on the other hand, it may be observed that the cost of the seed potatoes—80s. per ton—was very high, and that the crop, about five tons per acre, was comparatively a light one. There was no disease, but the shaws or stems, while green and luxuriant, began to decay on the 10th of September, and within five days became quite black, and the growth of the tuber was consequently checked, or rather stopped, altogether.

The pulling of the flax occupied from the 3d to the 8th of September; and the binding in small sheaves and setting-up, or stooking, required two days more. On the 28th of September it was carted to the thrashing-mill barn; but in place of rippling by the hand, the thrashing-machine was applied, which not only did the work effectually, but much more expeditiously, and at a considerably less cost. The sheaves were not put through the mill, but merely held so as to allow the beaters on the drum to strike off the bolls, and then withdrawn—the feeding rollers having previously been taken out of gear. After thrashing, the flax was carefully handled, and then stacked out until the following summer, when it was retted, bleached, and scutched in the usual way.

After the flax was carried, that part of the field on which it grew was ploughed and harrowed, the weeds and short broken-down straw collected and carted off. In the spring following, on the 13th of March, the whole field was ploughed, and seven days thereafter it was sown with Scotch barley. Very wet weather succeeded; and it was not until the 12th of April that grass seeds could be put in. The barley was then so fully rooted that it was not considered advisable to attempt to cover in the grass

seeds in the usual way; and as a substitute for harrowing, a piece of a small larch tree was mounted with furze, and drawn over the field, and then rolled. During the whole season not the slightest difference in the several divisions of the field could be discerned on the barley crop; in fact, it would have been impossible for the most experienced judge to have pointed out where the potato crop left off and the flax crop began, or where the flax left off and the Swedish turnips commenced. The produce, four quarters two bushels per acre, was uniform over the field; and although the acreage quantity was small, the quality was very superior, weighing 56½ lb. per bushel, and carried the first prize last spring at the Royal Northern Agricultural Society's show of seeds at Aberdeen.

Had the manure, however, which was given to the flax been reserved and applied to the barley, that part of the field would no doubt have been superior to the other divisions, while the flax crop would have been equally good, or nearly so, without manure.

The young grasses, the following spring and summer, were the finest and most luxuriant ever seen on the farms, and attracted the attention of every one who passed the field. The general belief was, that an extra quantity of seed must have been sown to produce such a flush of grass, but which certainly was not the case; the whole quantity allowed being only 12 bushels perennial rye-grass, 34 lb. of red, and 23 lb. of white clover seeds, for 12¼ acres; or at the rate of 1 bushel of rye-grass, and not quite 5 lb. of clover seeds, per acre.

To the many inquiries made regarding the process followed, and the quantities of seed sown, the short but simple reply was, that the seeds, more by accident than anything else, had been only *slightly covered*, in place of being *buried*. As stated throughout this report, and it may be repeated here, the *garden rake*—the brush-harrow would do equally well—was invariably used for covering in the flax seeds; and, in the opinion of the writer, rye-grass and clover, as well as flax and other small seeds, ought not to be put deeper in the soil than an inch, or even less.

The covering in the seed of five acres with rakes, and afterwards rolling the ground by manual labour, may appear somewhat paradoxical to the notions entertained regarding the economy of modern husbandry; but on referring to statement No. I, it will be found that the whole cost of these operations—sowing, raking, and rolling—was only twelve shillings, or at the rate of 2s. 5d. per acre; and provided wages for seven men for one day, six of them at 1s. 8d. each, and one at 2s. The same amount of money would only have paid for a man and a pair of horses for one day and six hours, at the usual charge of 7s. 6d. per day.

In the rotation, as noted at the beginning of this report, one crop of oats is taken after three-year-old lea, then flax, and after

it either wheat, barley, or bere, sown down with grass seeds; but had the soil and climate of the farms been suitable, wheat would in all cases have been preferred to any of the other cereals. The flax plant, being of rapid growth, gives ample space in the spring months to have the ground well cleaned and prepared; and although it may be desirable to have the seed sown in the beginning or middle of April, the first or second week of May is not too late. When sown about the beginning of May, and the seed allowed to come to maturity—and there seems to be no good reason why it should not always be ripened and saved—the flax generally is ready for pulling by the end of August, or at latest in the first week of September; thus affording plenty of time, after removing the flax from the ground, for the several operations of ploughing, cleaning, manuring, ploughing in manure, and then sowing with wheat, all by the middle or towards the end of September; and, consequently, giving the wheat after flax a very considerable advantage over the same crop when sown later on in the season after potatoes or turnips.

Flax should always be considered a green crop, and grown on part of the fallow break, so as not to interfere with the regular rotation, or lessen the usual quantity of fodder on the farm. The seed and bolls being used for feeding cattle, become a substitute for the turnip or potato crop displaced by that of the flax, and when so used, keep up the fertility of the soil equally with any other kind of green crop.

Linseed feeding is also a very valuable auxiliary, when the turnip crop happens in any way to be deficient, or even when it is abundant. The plan I have hitherto adopted is, to commence with eight ounces of linseed meal per day for an ox of forty-five to fifty stones weight, gradually increasing the allowance to twelve ounces, and finishing with one pound. In preparing the mash, we occasionally boil turnips; but the water is always allowed to come to the boil before putting in the linseed meal. After letting the whole simmer for about ten minutes, it is ladled into large tubs over layers of barley or oat chaff, and each layer, as it is put in, is beaten down with a small rammer. The compound requires twenty-four hours to cool, and is then given in quantities of about a stable pailful to each animal at one P. M., and again after the turnip feed at five P. M. A small quantity of flax chaff or bolls, boiled and mixed with other chaff or cut straw, makes excellent and nutritious food, either for stalled cattle or milk cows. To the horses we give the linseed ground, the same as for cattle; but only a few ounces at a time, mixed with bruised oats, and steeped in cold water.

In concluding this report, it may be remarked, that flax was grown more extensively in Scotland towards the end of last and beginning of the present century than now. The value of the fibre was then much greater; but being cultivated almost wholly

for the purposes of home manufacture and home use, very little note was taken of the cost of the raw material. It was after the introduction of machinery, in 1795, for the spinning of linen yarns, and which, in the course of twenty years, almost entirely superseded spinning by hand, that the culture of flax began to decrease. During that period—from 1795 to 1815—grain and cattle had also attained very high prices, which was another cause why the farmer became less anxious about growing flax. But now that the value of corn as well as of cattle has become so much depreciated, and, without some great exciting cause, will evidently be permanently depreciated, it becomes a question of importance whether the growing of flax, as part of the rotation on the farm, may not be beneficially practised.

In the north of Ireland, principally in the Province of Ulster, flax-culture is carried to a very considerable extent, and, under the auspices and fostering care of the Royal Flax Improvement Society, is now extending to the southern provinces. Last season the Irish farmers had almost 140,000 acres under cultivation; but to supply the wants of the United Kingdom, 600,000 acres would not be too much.

The soil and climate, in various parts of England and Ireland, may be slightly superior to that of Scotland for the culture of flax; but it has, nevertheless, been clearly shown, by the statements in the preceding pages, that flax may be profitably cultivated in Scotland, and that, too, without deteriorating the fertility of the soil, or in any way disarranging the regular rotation of the farm.

Estimating the arable land in Great Britain and Ireland at 48,000,000 acres, and were only 1¼ acres in every 100 acres sown with flax, the produce would be 120,000 tons of flax, besides codilla, 4,800,000 bushels of linseed, and 14,400,000 bushels of chaff—representing a value of £6,500,000; and of this sum at least £4,500,000 would be expended solely in labour.

The great desiderata, at the present time, in the growing of flax in this country, are ponds for steeping, and scutching-mills for dressing the flax. Along with the improvements by draining, the old *lint-pots*, as a natural consequence, have disappeared, and the scutching-mills, one after another, with very few exceptions, have gradually fallen into decay.

These wants, however, are likely soon to be supplied—the former by the introduction of the late Mr Schenck's patent hot-water system of retting, and the latter by various recent improvements in scutching machinery. In Ireland, there are now eighteen patent steeping establishments in operation. The Messrs Marshall of Leeds, Mr Fergus of Strathore in Fifeshire, and the Messrs Baxter, Dundee, are also all making trial of the new steeping system. Should it succeed—and, so far as it has yet been tried, there appears to be no reason to suppose that it will not—the grow-

ing of flax, and the preparation of the fibre, would then become two distinct and separate employments. The farmer would merely have to grow the flax, take off the seed, and sell the straw. In this way, flax-culture might be easily and profitably carried to a great extent, giving remunerative employment to a large number of the population, and at the same time not causing the smallest decrease of the produce required for the sustenance of the people.

III.—By Mr Walter Reid, Drem, East Lothian.

[Premium—The Gold Medal.]

Public attention has been of late much directed to the subject of flax, and its extended culture has been advocated as being more remunerative to the agriculturist than the crops generally grown, from the prices of the latter having (in the mean time at least) very considerably declined; while, from the increasing demand for the former, its value is being gradually enhanced.

In Scotland, its cultivation and preparation, for the uses of the manufacturer, are almost unknown to the present generation of farmers. It is, however, no new branch of agriculture, as is shown by the following extract from a work entitled *A General View of East Lothian*, by George Buchan Hepburn, Esq. of Smeaton, published in 1794:—

> In the year 1727, the Board for the Encouragement of Manufactures and Fisheries was instituted; and as the culture of flax was altogether unknown at that period, the Board had a certain number of surveyors instructed in the culture of flax, to each of whom they assigned a district of country, and by bounties they invited the husbandmen of each district to cultivate the plant under the direction of these surveyors, who superintended the business from the time of sowing the seed till the flax was watered and prepared for scutching.
>
> Mr Spalding, one of these surveyors, who had charge of this county, invented the water-machine now (1794) used for the scutching of flax, and under his direction the Board erected the first machine of the kind ever known in Great Britain at Gifford Mill, on the Tweeddale estate, in this county.

It may also be mentioned that to Mr Cockburn of Ormiston, known as an agricultural improver, belongs the honour of having erected the first bleachfield in Scotland at the village of that name; and the first commercial undertaking of the British Linen Company was at Salton, also in East Lothian, instituted in 1750 by Andrew Fletcher of Salton, Lord Justice Clerk, a nephew of the patriot, and first deputy-governor of that Company.*

In 1746, flax received great attention from the then Society for the Improvement of Agriculture; and the bounties given by the Board of Trustees were continued till within the last twenty years.

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* According to three years' average, ending with the year 1790, there were of linen made for sale in Haddingtonshire 26,875 yards, which were valued at £1866, 4s. 2d. sterling. According to the same average, ending with 1800, there were 27,221 yards, of the value of £1766, 5s. 6d. sterling.

Notwithstanding this encouragement, its cultivation gradually decreased. The high price of grain at the beginning of the present century contributed much to this result. Times have, however, changed; new and improved processes have been discovered for manufacturing the fibre, while the value of the seed for feeding purposes has become better known. This has re-directed attention to the subject. In Ireland, within these few years, its cultivation has made very considerable advances—the increase in the number of statute acres sown being 47,579 in 1851 over 1850. Brighter prospects have been augured for that unhappy country, from the impetus it is expected to give to its manufactures, and employment to its starving population.

In the spring of 1850, the following experiments were commenced, in order to ascertain whether it would be a paying crop in such a district as East Lothian. Some information, it is hoped, may be gleaned from a detailed account of it by those who purpose to engage in its cultivation, while some of the errors (unavoidable, perhaps) in a first experiment may serve as a beacon to be avoided. For the trial a piece of ground was selected containing 10 imperial acres, lying in a low and rather damp situation, about 40 to 50 feet only above the level of the sea, and at about 4 miles' distance from it. The soil may be characterised as an alluvial clay, with a mixture of moss containing under water, but tile-drained as deeply as practicable. It had been previously managed in the six-course rotation. The crop immediately preceding was grass, and was cut for soiling. To compensate for this, towards the end of autumn turnips and oilcake were eaten on the ground by sheep. It was ploughed in winter, and in March half of the ground was sown with oats, the crop for which the whole was intended. The other 5 acres, reserved for the flax, were reduced to a fine mould by means of the harrow and roller. After being rolled flat, they were sown on the 5th of April with Riga linseed, at the rate of 10 pecks to the imperial acre. The seed was covered with the ordinary grass-seed harrow, though some sort of bush harrow would have been preferable, as those seeds which were nearest the surface germinated first. After the plant was about 3 inches high, it was carefully hand-weeded.* About the beginning of August it was pulled, a slight yellowness of the straw giving indications of its becoming ripe. It was tied into sheaves about 8 or 9 inches in diameter, stooked in the same way as corn, and allowed to stand 'till dry enough to be carried to the stackyard. In the course of the winter it was divested of its seed, which was done by beating it out upon the barn-floor. The seed

* "In Scotland, a crop of flax, it is said, has been sometimes weeded by turning a flock of sheep at large into the field. They will not taste the young flax plants, but they will carefully search for the weeds, which they devour."—*Loudon's Encyclopædia of Agriculture.*

was cleaned by the ordinary winnowing machine; the straw was re-stacked, and stood till sent to be scutched. The whole expense and produce of both crops were as follows:—

EXPENSE OF OATS PER IMPERIAL ACRE.

	£	s.	d.
Ploughing, harrowing, and sowing,	£0	12	6
Seed, 4 bushels at 2s. 6d.,	0	10	0
Reaping,	0	8	0
Carrying to stackyard,	0	4	0
Thrashing, &c.,	0	9	0
	£2	3	6

PRODUCE OF OAT CROP.

	£	s.	d.
6 quarters at 18s.,	£5	8	0
171 stones straw at 4d.,	2	17	0
	£8	5	0
Deduct expenses,	2	3	6
Profit,	£6	1	6

EXPENSE OF FLAX CROP PER IMPERIAL ACRE.

	£	s.	d.
Ploughing,	£0	9	0
Harrowing, rolling, and sowing,	0	7	0
Cost of seed,	2	1	4
Hand weeding,	0	7	1½
Pulling,	0	11	8½
Carrying to stackyard,	0	3	0
Thrashing and cleaning seed,	1	0	0
	£4	19	2

PRODUCE OF FLAX CROP.

	£	s.	d.
18 bushels of seed at 9s.,	£8	2	0
32 cwt. of straw, as valued by Mr Fergus's manager at £2 per ton,	3	4	0
90 bushels of bolls, at 2d. per bushel,	0	15	0
	£12	1	0
Deduct expenses,	4	19	2
	£7	1	10
Deduct profit of oats,	6	1	6
Leaving	£1	0	4

in favour of the flax crop.

The seed may appear high at 9s. per bushel, but part of it was sold for sowing. In April last a statement something similar to the above was laid before a meeting of the Haddington Club. The following remarks were made upon it by Messrs Bernard and Koch of Creeganh, near Belfast, the proprietors of Schenck's patent steeping process, and which appeared at the time in the *North British Agriculturist*:—

That this crop must have been grown principally with a view to a large crop of seed—and we suspect the flax straw to be coarse and branchy; as in all our experience we have never known so large a proportion of seed to the weight of straw, when the latter is such as it should be,—that is, of moderate thickness, perfectly

free from branches, straight, and not too thin towards the point. The largest proportion of clean seed we have ever known to the weight of straw is 8 bushels to each ton of straw, (after seeding,) or about 6 bushels to a ton weighed off the field in a dry state. We have to remark, also, that the cost of seed for sowing should be at most £1, 10s., instead of £2, 1s. 4d. It should even be only 25s. (that is, 2½ bushels at 10s.) In 1850, flax seed sold at an extraordinary price, reaching 14s. or 15s. per bushel; but a farmer, having every year a crop of flax, benefits equally under such circumstances, as his proportion of seed fit for sowing is proportionally increased in value. Another overstated item as regards expense, is the cost of thrashing and cleaning the seed. No doubt it has cost £1 per acre in this instance, there not being proper implements; but with a seeding-machine and a dressing-machine, fitted expressly for the purpose, the cost is under 6d. per bushel of cleaned seed. On 18 bushels, the cost should then stand at 9s., instead of 20s.

Without venturing to speak decidedly as to how far the above remarks are correct, there can be no doubt but a large crop of seed must, to a certain extent, injure the fineness of the fibre; and seeing its value varies from £30 to £100 per ton and upwards, it must be a matter of calculation, only to be obtained after repeated trial, how far the one object ought to be sacrificed for the other. Instead of Mr Fergus's offer of £2 per ton for the thrashed straw being accepted, which, after deducting the cost of carriage, was less than its value for making manure, it was sent to the factory lately erected by him near Kirkaldy, for the purpose of steeping flax under Schenck's hot-water process.

Mr Wilson, the manager there, kindly undertook some experiments with it. The straw, amounting to 6 tons, was divided into four parcels, and each was steeped under a different method. No. 1 was retted on the old plan, in cold water; No. 2 in hot water; No. 3 in cold and then in hot water; and No. 4 twice in hot water. The loss in weight, after being steeped twice in hot, was 5 per cent above that steeped in cold water alone. This slight loss, however, is far more than compensated by its increased yield. After being scutched, No. 1 yielded 7.90 per cent of dressed flax; No. 2, 9.20; No. 3, 12.29; and No. 4, 12.96,—or very nearly double that done in cold water. Their values were respectively £34, £35, £38, and £45 per ton.

The following table was supplied by Mr Wilson:—

Received of straw,	tons 6	15	3	0		Produce,	tons 6	11	1	4
						Waste, 3.3 per cent, or	0	3	1	24
Received for vats,	tons 1	9	0	18	—for once retting cold.	Produce	1	3	1	2
	1	18	1	14	— „ „ hot,	„	1	9	1	27
	1	9	0	0	—for twice cold and hot,	„	1	2	0	25
	1	14	3	0	—for twice hot and hot,	„	1	6	2	27

Loss on once cold,	20.2	per cent.
Do. on once hot,	23.1	„
Do. on twice cold and hot,	23.3	„
Do. on twice hot and hot,	25.0	„

ONCE COLD.

Received for scutching, tons 1 3 1 2 . Produce, tons 0 1 3 12
Flax yield, 7.90 per cent.

ONCE HOT.

Received, tons 1 9 1 27 . . . Produce tons 0 2 2 24
Flax yield, 9.20 per cent.

TWICE COLD AND COLD.

Received, tons 1 2 0 25 . . . Produce, tons 0 2 2 6
Flax yield, 12.29 per cent.

TWICE HOT AND HOT.

Received, tons 1 6 2 27 . . . Produce, tons 0 3 1 24
Flax yield, 12.96 per cent.
Total tow—ton 0 2 2 20. Yield, 2.6 per cent.

On looking at this, one cannot help being struck with the superiority of Schenck's process over the old plan of retting in cold water. The increased and constant temperature of from 80° to 90° imparts a softness to the fibre, and a fineness to the colour, which, in some instances, increases the value of the one over the other as much as sixty per cent.

The whole produce of this flax crop, after the above experiments were completed, amounted to £21, 11s. 8d., while Mr Fergus's account for steeping and scutching amounted to £21, 14s. 8d.; so that I lost not only the whole straw, but 3s. besides. Had the straw, however, been prepared according to plan No. 4—namely, twice in hot water—its value would have been something near what Mr Wilson put upon it.

After the flax and oats were removed from the ground in the autumn of 1840, the part on which the flax was grown appeared considerably cleaner than the other. At this time the whole received twenty-five cart-loads of farmyard manure per acre. In spring it was drilled up in the ordinary manner for beans, which were sown at the rate of four bushels per acre. During summer, the greater luxuriance of those upon the flax ground could be seen at a very considerable distance. They are now thrashed, and the results will probably surprise those who consider flax as an exhausting crop. The produce and value per imperial acre are as follows:—

	£	s.	d.
From the ground after Oats.			
3 quarters 1 bushel, weighing 63½ lb. per bushel, at 30s. 6d. per qr.,	£5	4	3¾
161 stones straw, at 4d., ...	2	13	8
	7	17	11¾
From the ground after Flax.			
3 quarters 7 bushels, weighing 64¼ lb. per bushel, at 32s. per qr.,	6	4	0
217 stones straw, at 4d., ...	3	12	4
	9	16	4
Difference of value in favour of the crop after flax, ...	£1	18	4¼

The beans were sold in Haddington market, and brought the prices attached to them. Few will be inclined to value the straw

under 4d. a stone: many attach a higher value to it, which would make the contrast still greater.

In districts where the turnip husbandry can be fully carried out, ample employment can generally be found for the whole of the agricultural population. The weeding of the flax would interfere with the operations connected with this crop. Under such circumstances, its cultivation ought to be entered into with caution. There are situations, however, where the case is very different; and when it is kept in view that the expenses of raising flax, such as weeding, pulling, and arranging it for the different processes, preparatory to its being manufactured, far exceed that of any other crop, its adoption there may perhaps be more strongly recommended, giving employment of a less laborious nature than the ordinary operations of the farm. As, even in this instance, had the straw been sold, a small profit would have been obtained, surely, in less favoured districts, the erection of such works as Mr Fergus's, and the growth of an article which the country imports, in flax seed and oilcakes, to the extent of between seven and eight millions annually, are objects deserving every encouragement and support.

ON THE CULTURE OF THE LENTIL.

By M. Achille François Guillerez, Professor of French, Edinburgh.

[Premium—The Gold Medal.]

The common lentil is the *Ervum lens* of the botanists. Its *generic characters* are, calyx five-parted; segments, linear acute; corolla, sub-equal; pod, oblong, two and four seeded. Six species are natives of the northern hemisphere. *Ervum lens*, the lentil, is a native of the south of Europe; its eatable cuticular seed is of very ancient cultivation. *Ervum tetraspermum*, *E. hirsutum*, are the troublesome weeds named *tares* in Scripture: they are natives of England.

Native names.—1. In the Sikh States—"the cradle of mankind," and probably its original habitat and centre of distribution—the lentil is called *Masur*—(Masir, in Arabic, signifies *Egypt.*) Mr P. Edgeworth, C.S. Masuri, gives a botanico-agricultural account of the protected Sikh States on the plains of the Sutlej and the Jumna, in which he states that *Masur* (*Ervum lens*) is very little cultivated in the Dakh (*Butea frondosa*) tract; but in the Babul (*Acacia arabica*) country, (distinguishing the districts by the prevalence of these plants,) *Masur* is abundant in the lower lands of

stiffer soil. In a third tract, Phalahi, (*Acacia modesta*,) Mr Edgeworth says,—"*Masur* I have never seen in this tract."—*Jour. Asiat. Soc.*, No. 81, September 1838. HOOKER'S *Journal of Botany*, vol. ii., 1840, p. 267.

2. SYRIA, *Adas*.—Dr ROBINSON'S *Travels*, vol. i. p. 246.

3. SICILY.—Much eaten, and named *Lenticchia*.— *Classical Plants of Sicily*, by J. HOGG, Esq., A.M., in the *Trans. of the Linnæan Society*, Nov. 2 and 16, Dec. 21, 1830.

4. FRANCE, *Lentille commune*, *Grosse lentille*, *Lentille blonde*.—"Du midi de la France. Très-cultivées aux environs de Paris, soit dans les jardins, soit en plein champ, ou on les sème en touffes ou en rayons et plus rarement à la volée (broadcast.) Une variété dite *Lentille rouge*, (*Ervum lens minor*,) est très-estimée. Bosc rappelle que les anciens avaient l'habitude de faire germer les lentilles avant de les faire cuire pour déveloper leur principe sucré."—*Bon Jardinier*, 1848—voce *Lentille*.

Having so far supplied these required particulars, it may be observed that the progress of lentil cultivation may thus be traced from Syria and the East into Arabia, where it is recommended as food for those who undertake long journeys. We can hence perceive how it was carried into Spain and the south of Europe during the intercourse with the Moors, and from Spain found its way into France, Italy, and the country into whose agricultural economy it most largely enters—Germany. It would unnecessarily occupy time to state—from Berghaus, Johnston, or any other Physical Atlas—the elevations and soils of these successive localities. I have carried the matter a stage farther, by subjecting the crop in this country to the actual test of culture, and trust that this important experimental fact will be regarded as superseding all other extraneous information which might certainly be offered with ease—more especially as I have specifically pointed out the natural habits and qualities, as well as uses, of the cultivated plant, and supplied specimens of the produce.

I was induced to undertake the cultivation of this prolific leguminous plant, because I was aware of the extent to which it was applied as a staple of subsistence on the Continent of Europe and elsewhere; and my object has been to counteract, in many districts of Great Britain, the effects of the potato failure.

The use of lentils as the food of man can be traced from the most remote antiquity. In Genesis xxv. 29, it is said,—"And Jacob sod pottage;" and in the next verse, "And Esau said to Jacob, Feed me, I pray thee, with that same *red* pottage;" and this, we are finally informed in verse 34, was "*pottage of lentiles*." Dr Shaw, (*Trav.*, p. 140, 4th edit.,) speaking of the inhabitants of Barbary, says,—"Beans, *lentils*, kidney-beans, and garvanços, are the chiefest of their pulse kind; beans, when boiled and stewed with oil and garlic, are the principal food of persons of all distinc-

tions; *lentils are dressed in the same manner with beans*, dissolving easily into a mass, and making pottage of a *chocolate* colour." We adduce Dr Shaw's own words, because Dr Jamieson (*Nat. Hist. of* PAXTON'S *Illustrations of Scripture*, p. 28) and others have singularly confused this statement. Lentils, then, on the authority of Genesis, xxv. 34, formed the mess for which Esau sold his birthright. Lentils are several times mentioned in Scripture—2 Sam. xvii. 28; xxiii. 11; and Ezek. iv. 9. Down to the present day they constitute the ordinary food of the common people of many Continental States. Indeed, the lentil either derives its common name (*Erv.*, tilled land, *Celtic*; and *Lentil*, *Celtic*) from being the principal means of subsistence, plainly boiled, or dressed with vinegar and oil, during Lent, in Catholic countries; or, otherwise, Lent, with equal probability, has been so designated from the general use of the lentil during that season of fasting and penitence. It is well known, too, that abroad lentils form not only the cheapest, but the most nutritious and palatable diet for the people—the value of twopenceworth, very simply cooked, being usually sufficient to dine six men.

Lentils, where they are eaten, are the most popular of all dishes. The finest, or small brown kind—which is, *de facto*, the most prolific, producing generally two small beans to the pod for one produced by the larger and the yellow sort more commonly raised—is esteemed as a delicacy by the rich as well as by the poor. Recently the flour of lentils has been introduced by puffing vendors into this country as a medicinal food for invalids requiring regimen, under the names of Revalenta, Ervalenta, &c. But the comparatively high price put upon it has precluded the public deriving due advantage from the introduction of so nutritive a species of food.

Knowing these facts, I confess that it struck me with astonishment, upon the failure of the potato crop in this country, to find that here the cultivation of lentils, as the food of man, had been completely neglected. I therefore resolved to undertake the task of leading the way, in however humble and imperfect a fashion, for the general adoption and introduction into the rotation of crops of so important a substitute for that precarious esculent, a reliance on which has so treacherously betrayed thousands of the British and Irish poor into destitution, disease, and death.

It may be remarked that, although the great crisis of the potato rot would *seem* to have now passed over, still the disease has not entirely disappeared, and in all probability *never will*. At present partial failures—in the Isle of Skye total—and in some other instances to a rather alarming extent, with universal doubts of the possibility of effectually and safely storing for distant dates any considerable portion of the present year's crop of potatoes, significantly indicate the hazard, not to say the folly, of a continued and

exclusive reliance on the *solanum tuberosum* as an element of subsistence.

Such an important circumstance induced me to enter specimens of my Scottish lentil crop for the Great Exhibition of 1851, and now I submit the following mode of cultivating it to the agriculturists of Britain.

As appears from Lawson's *Agricultural Manual*, (Blackwood, 1836,) "the lentil is said to have been first introduced into Britain about the year 1545; but, *although well adapted to our climate*, its cultivation has never been attended to."

I have now discovered that the seed which I had myself raised and planted from my own produce in this country, has proved much more luxuriant in growth and prolific in produce than continental seed newly imported from France, and given me in exchange by the Hon. Lord Murray. This fact I regard as a sufficient test that my lentils are already acclimated. I now entertain not a doubt that they will be found to grow in this country, generally, even more luxuriantly than in France.

The late eminent Dr Patrick Neill tried to cultivate the lentil, it is believed, about twenty years ago, at Canonmills, but did not succeed.

Messrs Lawson mention having ripened at the Meadowbank Nursery, Edinburgh, their specimens of the larger lentil, but not the small brown kind of a preferable flavour for food, as already indicated. Theirs were sown 7th April 1835, were in flower 6th July, and ripened the second week of August, at the height of 2 feet 3 inches.

Somewhat similar dates and results have characterised my cultivation, only my plants grew to 3, and even 3½ feet in height. I find it immaterial attempting to sow or bring forward the crop earlier in this climate; if the attempt is made, the climate will counteract it. But I must acknowledge not having been altogether privileged to make my trials under circumstances the most favourable for the growth of the plant. A dry warm soil is requisite for the lentil; yet I sowed them at South Queensferry in a heavy soil, manured with sea-weed and common dung. They were committed to the earth at various periods—some two months earlier than others—but, as already hinted, without a corresponding advantage in earliness or maturity. The result of my observations are, that the lentil ought, in fact, to be sown a little later than the pea; and at the rate, say of one to one and a half bushels to the acre. Its treatment and harvesting may, in every other respect save sowing, resemble those applied to the pea.

The best time for sowing lentils in Scotland is about the middle of March.

The best and most economical mode of sowing them is probably to plant a row of horse-beans between each row of lentils, in order

to prevent their falling upon the ground, and thus to save any expense in propping, although no such expense is ever indeed incurred in field practice. In France they are very seldom sown broadcast, and they require little propping, because the rain and the winds are not so heavy as here at the time of budding. The plant, as Lawson says, is "of a close branching habit of growth; and one plant will produce from 100 to 150, and often a considerably greater number of pods"—(*Manual*, p. 95.) I have counted 134 pods on a single stalk, and found the pod to contain (I speak of the larger plant cultivated by Lawson) from one to two, and occasionally three seeds. In gardens, lentils may, of course, be sown in pretty thick rows, at the distance of from 18 inches to 2 feet apart, with the plant at least 5 inches distant in the rows; and in these cases they certainly have a better appearance propped. In fields, as already stated, they are never propped, but sown like tares.

In 1849, I planted about a handful of lentils in rows, like peas, in a very cold soil at South Queensferry, and gathered subsequently therefrom about two pints. I then supposed that, had I been able to attend to the cultivation, and had my lentils been planted in February in place of April, in a sunny, sheltered, yet *moist* exposure, instead of where they grew, the crop of 1849 would have amounted to nearly half a bushel; for the lentil is a vegetable of very prolific and hardy disposition, provided it be duly cheered by the continued moisture and sunshine of a southern exposure. I did not, however, in 1850, quite realise these sanguine expectations, especially in reference to early sowing being followed by early maturity. On the contrary, I had to re-sow the early sown portion of my crop of large lentils devoured by the birds in spring; the other, that is to say the smaller, not having been touched at all, either by bird or insect depredator; and probably the bulkier germ of the larger plant would prove the more attractive to these creatures.

There are three varieties of the *Ervum lens* cultivated in France for human food—

1. The Large.—Pods, when ripe, about $\frac{3}{4}$ of an inch in length, by $\frac{1}{2}$ in breadth—flattened, and containing generally only one seed, which, if round and compressed, about $\frac{3}{8}$ of an inch in diameter, and about $\frac{1}{8}$ in thickness, of a whitish or cream colour. The large and the yellow sort are almost always mixed in trade.

2. The Yellow Lentil, which is less, and very easily unhusked—converts readily into flour, and serves for the base of those preparations which have been so much and so long puffed in the newspapers. It is in great use in France.

Finally: The Small Brown Lentil, which is the best for use, has the most agreeable flavour, and is preferable to all others for haricots and soups.

Those three varieties have been grown, and their seed ripened by me in the open air, with the greatest facility; although I have failed to learn that this has hitherto been anywhere else accomplished in this country.

The following details of two plots under culture in 1850 are indicative of the results respectively obtained:—

PLOT I.—Small Brown Lentils, 20 feet by 10 feet in area.

Seed sown.—Early in March, weighing $\frac{3}{4}$ths of a lb., in 14 rows, 17 inches apart, but found, from luxuriance of the haulm, to be much too close.

Produce of the plot.—Cleaned and in perfect condition 15th September 1850; weight 12 lb.; but about as much again had been destroyed by birds, or freely trowelled up for specimens of the growing plant.

Weight of seed saved.—4$\frac{1}{4}$ lb. to the forpet.*

Quality and flavour.—Cooked whole, and tasted, with a slice of Strasburg bacon, exquisite, and met with high approval at table.

PLOT II.—Large and Yellow Lentils. In extent 10 feet square.

Seed sown.—About $\frac{1}{2}$ lb. in 7 rows, 18 inches apart, but the same as to proximity of rows as Plot I.

Produce.—Apparently most productive; but at 15th September destroyed to within a few pounds by birds. Several pounds have been saved since; but the plot might easily have yielded from 15 lb. to 20 lb. if planted and pulled along with Plot I.; for Plot II. were at first destroyed in the ground whilst germinating, and re-sown in April. Blackbirds are especially destructive to them.

Weight of seed.—4$\frac{3}{4}$ lb. to the forpet.

Quality.—Round and flat, produced abundantly in large, flat, square-like pods, with one seed—rarely two; pale yellow, or cream-coloured.

I shall now state the result of my experience in the year 1851.

I had selected a larger spot, at South Queensferry, exposed to all winds, on a declivity, by the sea side. The extent of ground sown with lentils was 75 feet in length by 34 in breadth, and also a small spot of 15 feet in length by 4 feet in breadth for forage. The quantity of lentils sown was 5$\frac{3}{4}$ lb., and perhaps $\frac{1}{2}$ lb. for forage; but of this latter we shall speak anon. Half of them, including the *large*, were propped with stakes, and produced about 122 lb.; the other half, composed of the *small* and *middle* size, (a new variety received from France by me last year,) was also planted in drills, but propped by two rows of beans for each row of lentils. The crop of beans was most prolific; but as they were planted not close enough to the lentils, the latter were laid by the heavy rains of August, at the time they were budding; and the

* Forpet—that is, fourth part of a peck, and containing rather more than 137 solid inches.—EDITOR.

crop, which at first appeared to be very heavy, was partially destroyed, and amounted only to 44 lb. or thereabout.

In consequence of my observations during last year, it seems to me, 1st, That the lentils succeed better when they are propped by stakes; that they must have air at the top, and not be propped like peas, but at a distance of 6 inches on both sides, and the stakes must be straight, and not bent towards the top; that the distance between the drills must be 2½ feet; that cabbage, salsify, beetroot, cauliflowers, may be planted, and thrive very well in the interval, and that they (the lentils) must be earthed up when they are about 3 inches above the ground, so as to shelter them, when still tender, from the frost of March and April. 2dly, That the lentils sown with two rows of beans, 6 inches apart on each side, may succeed as well as when propped with stakes, provided the beans are planted when the lentils are 2 or 3 inches above ground, in order to prevent them from being choked, because the beans grow quicker than the lentils; that the beans must not be allowed to grow above 2½ feet; that the distance between the rows must be at least 18 inches in open fields, and 2 feet in gardens, and in either case that nothing must be planted in the intervals: they were earthed up before planting the beans. There was scarcely any manure put in the ground; and I noticed that the spots where lime and rubbish had been put the year before, were more healthy; whilst in richly-manured soil (for I tried it) the straw was taller and very thick, but the seeds not so abundant.

It would be important, if possible, to frighten the birds away when the lentils are budding, for they deserted a corn-field hard by to fall upon the lentils.

As to the lentils sown in a very rich ground for forage, they grew to the height of 3½ and even 4 feet. They were cut three times—end of May, end of June, beginning of August—and produced very few seeds, except between the second and last cutting, when they were not allowed to ripen, but given to sheep, horses, and cows—all very fond of them—so much so, that a horse followed me like a dog, and licked my hands, although I had no lentils to give.

Provost Taylor of Queensferry succeeded in sowing them broadcast along with beans; but Mr Dundas, of Dundas Castle, got them choked by too many beans; whilst Mr Ritchie of New Gardens had a hatful from a small handful of seeds.

I think they will grow better in drills than broadcast, in sandy and calcareous soils than in rich grounds; and that as forage, they would repay the farmer better than tares or beans, on account of the highly nutritious quality and tenderness of the haulm, either green or dried. As a garden plant, they are certainly superior to peas, being more prolific, more nutritious, and more pleasant to the taste. I cultivated also a red lentil, said to be from Bengal,

but I had a handful only of them, and they appear to me very like the small kind, except in the colour of the seed.

The straw of the lentil is very delicate, and even nourishing, prepared as food for lambs. A horse, to which the straw was given, consumed it green with great avidity.

The grain on the Continent sells nearly at double the price of peas. There is more nutrition in one part of lentils than in two parts of peas. Lentils swell much in cooking. Einhoff obtained from 3840 parts of lentils 1260 of starch, (fécule,) and 1433 of a matter analogous to animal matter, (azote.)

In tracing the progress of lentil cultivation, I may mention that, so early as February 12, 1850, I wrote a scientific notice of the lentil, urging the attempt to cultivate it in this country as a great resource for the poor, and an excellent substitute for potatoes; stating, moreover, that a pint of the meal, or one of the lentils unhusked and entire, enough to make two large dishes of food, might, even now, be bought here for sixpence. And in consequence of such a notice appearing in an Agricultural Journal, the cultivation of lentils was introduced into the allotment gardens of the Scottish Patriotic Society at the Dean.

In concluding this paper, it may not be amiss for me to annex here a notice of the various modes of preparing lentils, which I have seen observed abroad, and generally recommended here:—

1. Steep the lentils in cold water an hour or two; withdraw them and place them in a pan, with enough of water to cover the surface; a little butter, some salt, flavour with parsley; place the whole on a slow fire. They must boil slowly, and you must take care to add water enough to keep the surface covered, but merely covered.

2. You may boil them with ham, bacon, sausage, or merely with water and salt, or prepare them afterwards with onion *à la maître d'hôtel.*

3. In schools, barracks, or large boarding establishments, they are often merely boiled in salt and water; then they are allowed to cool, and the water to run out; and in that state they are dressed with oil, vinegar, &c., like a French salad.

4. When the lentil is bruised or ground into meal, it makes an excellent *purée* with wild fowl or roasted game.

5. It is prepared also like peas for soups, dumplings, puddings, &c.

One single pound of meal makes soup sufficient for fifteen persons; or a pudding, dumpling, *purée*, &c., for six; and the pound costs from twopence to threepence in France or Germany.

Being more nutritious than potatoes, peas, beans, &c., lentils would make a capital substitute for them.*

The crop of this year, June 1852, looks most beautiful in the same spot, South Queensferry.

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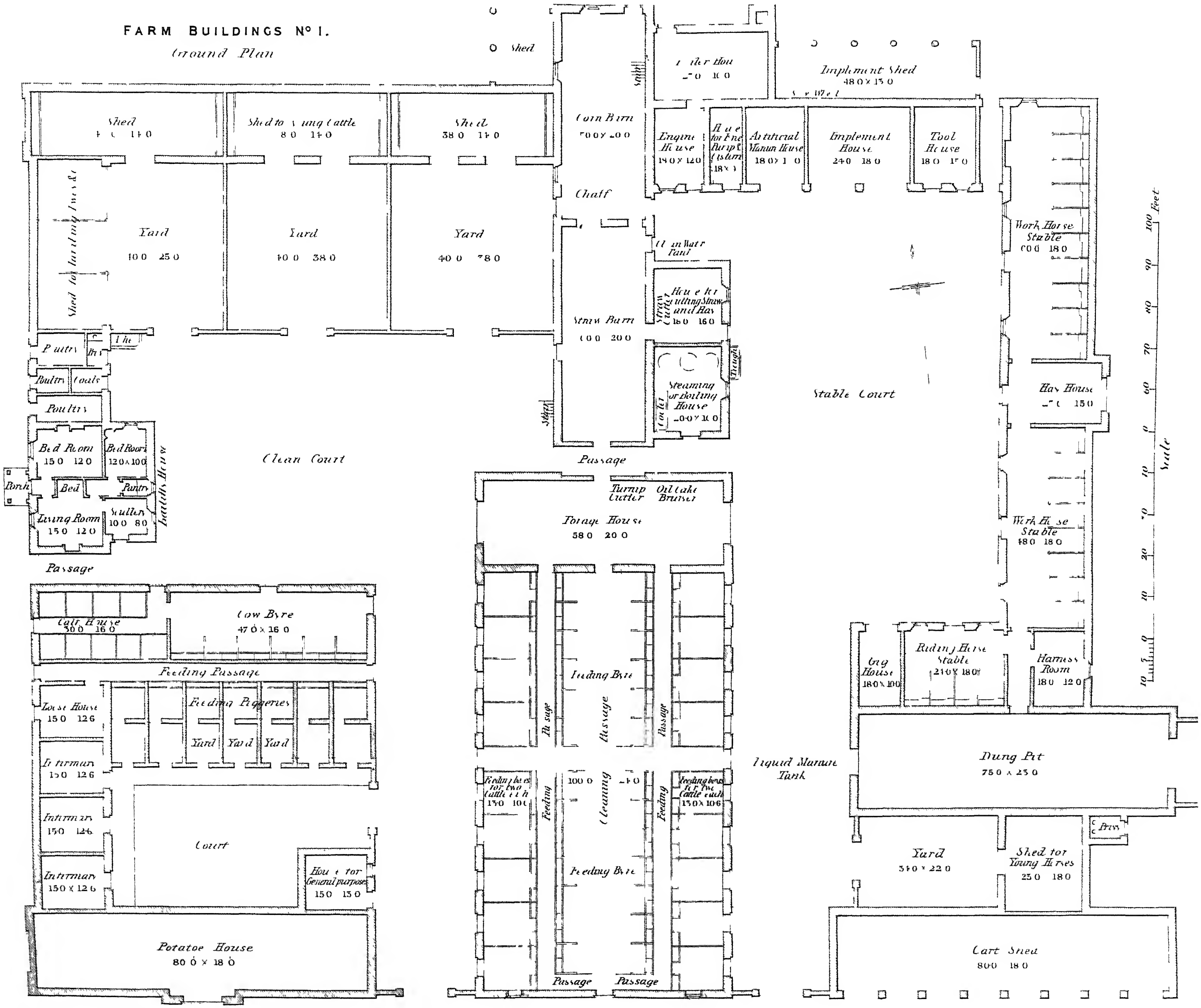
* See Playfair, J. Leibig, Royle, the analysis by Eichoff, *Le Bon Jardinier.*

FARM BUILDINGS No I.

Ground Plan



Schenck & McFarlane Lithrs Edinr

John Hogarth Archt
EDINBURGH

PLAN OF A STEADING FOR A FARM OF 500 ACRES, UNDER THE MIXED SYSTEM OF HUSBANDRY, WITH SPECIFICATION.

By JOHN STARFORTH, Architect, Edinburgh.

[Premium—The Gold Medal.]

IN designing farm-buildings that may be suitable for various localities, a number of insurmountable circumstances arise. Each locality has some difference in the system of management, and almost every farmer adopts some peculiar mode of housing and feeding his stock. There are, besides, the many conflicting opinions that exist among practical men at present upon the important point of the best system of feeding cattle, which experiments hitherto have been unable to decide, some still preferring the old system of large open courts, others feeding in stalls, whilst others prefer loose boxes. If practical men cannot determine the best mode of feeding, it is scarcely to be expected that architects can do so. Among the different systems suggested, many practical men are in favour of stalls and loose boxes for cattle, and covered houses, having open boarded floors, for pigs and sheep, which I have no doubt, will ere long be extensively practised.

It is very apparent that the generality of existing steadings have been erected without a sufficient knowledge of the purposes the various buildings had to serve. And another reason which may be assigned for such incongruous masses is, that they have been built, from time to time, without any general plan in view—erected to serve some peculiarity of management which each succeeding tenant might adopt; so that the houses which were convenient for the old system of farming, are now found to be quite inappropriate for the present improved modes of rearing and feeding stock.

However small a homestead is intended to be, it should be built according to a properly arranged plan, so that it could be added to at a future time, and still made more perfect, instead of additional buildings being so placed as to render the operation of the plan a daily waste of the farm-produce, and labour in attending the cattle so housed.

To determine the site for a proposed steading, as in the present case, is impracticable: circumstances alone must govern it. The nature of the ground as to its level, its proximity to a public road, and a situation such, that it may command a plentiful supply of water, are circumstances which must or ought to determine its position.

To design a set of farm-buildings upon the most approved principles, that shall contain all the necessary accommodation, in

the most convenient and symmetrical form, I have endeavoured in the present plan to attain; neither confining the buildings in such a concentrated form, as not to allow sufficient space to perform the various operations required, or proper ventilation for the animals housed; nor to place them in such a diffuse manner as to entail unnecessary labour and waste in their superintendence. The system of feeding and housing the various animals which I have introduced, and which it is my present purpose to explain, has been suggested by many of the most scientific agriculturists of the day, and is considered by them as the best they have tried.

Upon inspecting the ground plan No. I. in Plate VI., it will be seen that the corn-barn, with the sheaf-loft and machinery above, occupies a central position in the north range, where it is contiguous to the stackyard, having a covered shed attached for putting carts into when unloading the sheaves into the barn; and this is found highly necessary, as when a heavy rain may happen to fall during the operation of carting in the corn, the loaded cart is put under the shed, and the stack is covered by an oil cloth cover; and the whole is thus protected from rain.

The chaff is taken from the chaff-house (which is boxed off the corn-barn) into the courts for young cattle, where it is used for litter. The corn-barn I would recommend should be floored with timber, and properly protected from damp and the inroad of vermin.

The straw-barn extends towards the centre of the buildings, and is conveniently situated for distributing the straw to any place where it may be required, and nearest to those places where the greatest amount of it will be consumed. Adjoining the straw-barn is the house for cutting straw, and also hay if required, being close to the steaming-house.

The engine and boiler houses are situated to the east of the corn-barn, with a room fitted up above the former for drying. These, together with the artificial-manure house, implement-house, and tool-house, occupy the range on the north of the stable court, having a granary above the latter places for storing corn.

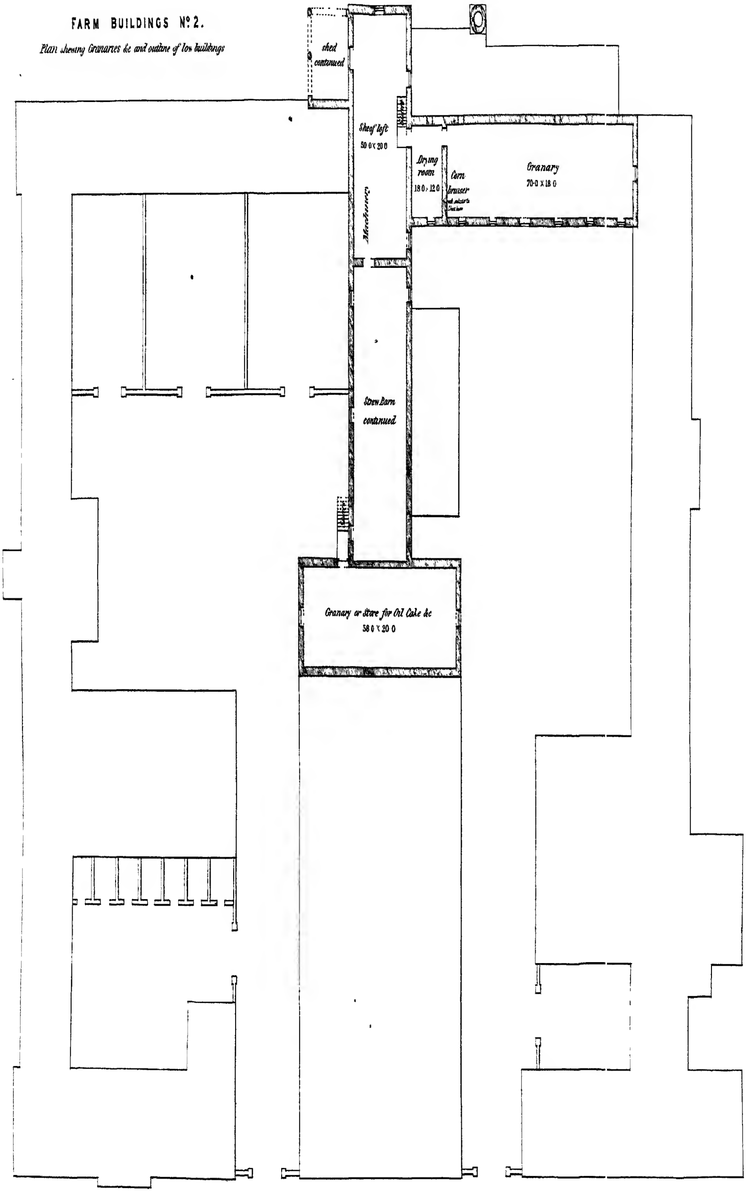
The work-horse and riding-horse stables, with the hay-house, and harness-room, and shed for young horses, are situated in the east range, where there is ready access from the straw-barn and steaming-house, and also for depositing the dung into the manure-pit, which is situated between the riding-horse stable and shed.

The stables are shown as being lighted by windows in the walls having fixed sashes. To this some may object, and many recommend they should be lighted from the roof; and those who approve of roof lights, such can easily be adopted by using unfinished plate-glass, the same as is proposed for the byres, &c.

In the centre of the buildings, and separated from the straw-barn by a passage of communication, is the forage-house, or kitchen

FARM BUILDINGS No. 2.

Plan shewing Granaries &c and outline of low buildings



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of the steading, where the food is prepared, and distributed along the passages of the feeding-byre, which will be seen to contain, in the centre division, stalls for feeding fifty-two cattle; and on each side nine boxes, for feeding two cattle in each. The manure from the centre feeding-byre is readily conveyed to the dung-pit through the centre passage, and the manure channel flushed with water to the liquid-manure tank, so that the whole is with economy and expedition cleansed. The divisions in the feeding-byre will be fitted up, varying a little in size, so as to accommodate greater or lesser animals. Below each feeding-passage is carried a cold-air trunk, having openings in the passage covered by cast-iron gratings, as shown by the dotted lines on the plan, for admitting fresh air, and the whole rendered healthy by ventilators on the roof, as seen in the isometrical view, No. III., Plate VIII. The building is also lighted by skylights in the roof.

Above the forage-house is a granary, or store for oil and rape-cake, where it can readily be put down to the cake-bruiser in the forage-house below, or, if preferred, the bruiser can be placed in the granary, and this—with the turnip-cutter, straw-cutter, and corn-bruiser—can be driven by a connection from the engine.

To the west of the feeding-byre is the cow-byre, calf-house, and piggeries, which—with the infirmary, loose-house, and potato-house—form the south-west division of the steading; the cow-byre and piggeries being conveniently situated for the forage-house and steaming-house. The piggeries will be supplied with food from a feeding-passage, having swing-doors above the troughs. Should more accommodation be required for servants' cows, it is proposed they should stand in the feeding-byre.

The range to the west of the corn-barn is occupied by sheds and courts for young stock, with a shed for lambing ewes or other purposes, the divisions being movable; adjoining which is the poultry-houses, which, with the bailiff's house, are situated in the west range, as being the most healthy position for a family, and the poultry having ready and free access to the stackyard, without coming in contact with the cattle. By some, the poultry-houses may be considered too small; but should they be required larger, they can easily be extended further into the shed adjoining, and greater accommodation obtained.

The steaming apparatus is supplied with the waste steam from the engine boiler; but when the engine is not in use, a smaller boiler will be used for the purpose, placed beside the larger one. The steaming-pans will all be made to revolve, and at once empty themselves into the barrows, by which the food is conveyed through the various passages. The system of boiling the food may be preferred by some, which can easily be substituted for the steaming apparatus, by placing the flue in the east wall. Steam pipes may also be conveyed through below the floor of the feeding-byre,

below the animals, if such be required, for the purpose of keeping the byre at a proper temperature during winter; a system which has been adopted in several instances.

In the implement-shed, adjoining the boiler-house, is a saw-wheel, driven by the engine, for the purpose of cutting any timber that may be required on the farm. Adjoining the engine-house is situated a double-action force-pump, which will be used for pumping the liquid manure over the dung, or forcing it from the steading for the purpose of irrigation, if such should be required; and also for filling a large cistern with water, which is situated beside it for supplying all the places with water that require it, if such cannot be accomplished by gravitation from a spring on the farm. Mill-stones for grinding grain may also be erected in connection with the shaft of the engine which passes from the fly-wheel immediately below the floor of the sheaf-loft, where it does not interfere with any communication.

It will readily be seen, by inspecting the plan No. II. in Plate VII., there are no lofts above any houses where horses or cattle are kept; and for the same reason the houses below the granary are placed in that situation.

From this explanation—the specifications, plans, and isometrical view—I trust the arrangement and construction of the whole apartments are sufficiently clear. It, however, may be necessary to state, that the height of all the two-story buildings is 16 feet to the top of the walls; and all the other buildings of heights sufficient to afford health and comfort to the animals housed in them.

Upon examining the isometrical view, No. III., Plate VIII., it perhaps may be considered that the buildings present a deficiency in architectural feature; but such in the present case is intentional; as the arrangement of the plan, and construction of all the interior fittings, have been studied to be of the most perfect and substantial nature—such being indispensable to form a complete steading, and the necessary expense of which cannot be avoided. And as it was requisite that the estimate should be as limited as possible, I have deemed it proper to render the plan complete and substantial, without incurring any expense that might be avoided.

I, however, do not advocate that farm-buildings should of necessity be plain, and devoid of architectural character; for where money can be so expended, I consider it an improvement; and such can easily be accomplished if required.

I have not shown the position the farm-house should occupy in relation to the steading, as such can only be properly determined from the nature of the ground on which it is about to be erected; but I consider it should occupy a position at some little distance from the steading, and to the south-west of it, where there will be ready and convenient access from the kitchen-offices to the cow-byre, calf-house, piggeries, &c., on the west of the stead-

ing; and such a situation will afford clear and airy grounds to the south and west fronts of the house. The bailiff's house, with the labourers' cottages, I would recommend to be placed at a convenient distance from the farmery, and not in it; and the reason why it is placed in it, was out of deference to the opinion of certain members of the Society, who conceive it as a matter of importance to have the superintendent of the farm residing in the steading. When the cottages of the servants are placed at a little distance, their occupiers might have small gardens, and other conveniences, such as would render their dwellings comfortable and perfect.

Various modifications might be made in the plan, without affecting its general usefulness; such as the carts might be placed under the granary, on the north side of the stable-court, and where they would be enclosed within the gates, and which plan I would prefer. The smiths' and carpenters' shops, as also the site for a weighing-machine, might be chosen conveniently for the steading—when the former are required at a steading—but which are generally situate in a convenient part of the estate, or in a neighbouring village. A feeding-house for sheep, having open-boarded floors, and the manure passed and flushed with water to the liquid-manure tank, could be constructed at a convenient situation; and such an arrangement was designed, but relinquished solely because it has not yet been adopted in general practice. Some desire a place for servants to sleep in above the hay-house or stable, in order to be near the horses during the night, which could be obtained above the hay-house in the present plan.

SPECIFICATION.

The following is an outline or general specification of the workmanship, and materials used, in constructing a farm-steading as the preceding, and which are considered sufficient in the present case, as a complete specification could not be made unless perfect working plans and detailed drawings were prepared.

The whole surface for site of buildings will be properly drained to the liquid-manure tank. The tracks for foundations will be dug out to the depth of 21 inches below the general level of the ground, or further if a sufficient foundation is not obtained. The floors for feeding-boxes to be dug out to the depth of 15 inches below the finished level of ground, and the yards to slope 12 inches from the outside towards the centre. The areas for the different floors will be dug out so as to allow the sleepers, pavement, or causeway being laid (generally) 3 inches above the ground-level.

All the soil or other substance, arising from the excavations, to be removed as may be directed.

The liquid-manure drains, as shown by the dotted lines on the plan, will be executed with drain-tubes from 4 to 8 inches diameter, glazed inside, having spigot and faucet joints, fixed with Roman cement, and laid with a declivity of 3 inches to 10 feet.

The walls will be founded with large flat-bedded stones, about 6 inches thick, forming 6-inch scarcements on each side. The walls will be of good rubble-work, built crossband throughout, having a header, extending two-thirds through the wall, in every square yard. All the stones will be laid on their natural beds, and the lime mixed with sharp pit or river sand, in proper proportions. The walls of all the two-story buildings, and riding-horse stable, will be beam-filled, close up to the sarking. The walls enclosing cattle courts will be 6 feet high, and those of the piggery courts 4 feet high, and all coped by a semicircular hammer-dressed cope.

The engine-stalk will be built with stone to the height of the roof of the boiler-house, and above with circular brick—the whole height being about 50 feet. The flue to be lined with firebrick to the height of 12 feet from the bottom.

The urine-tank will be 10 feet deep, arched over with brick or stone, and pointed with Roman cement inside, having an access at the top.

The gate-pillars, arches of cart-shed, cattle-sheds, and archways, will have a 2-inch chamfer taken off the angles. The door and window rybates, sills, and lintels, will be droved on the ingoings; and those, together with the various piers, arches, gate-pillars, &c., will have a 1½-inch droved margin on each face; and the rybates and corners will be built regularly out and inband. The skews, chimney-copes, &c., will also be droved.

The divisions in feeding and cow byres will be executed with droved stone 5 inches thick, and droved stone troughs, constructed so as to admit of a flow of water throughout the whole. The cast-iron pillars supporting roofs, and all upright timber posts, to rest on large square stones.

The air-trunks below passages will be built with stone, and covered with rough pavement, having openings for ventilation, covered with cast-iron gratings, as shown by the dotted lines on the plan. The urine channels in stables will be executed with droved stone, laid to a proper declivity. The cooler in steaming-house will be executed with droved pavement. The outside stair and plat to granary, above forage-house, will also be executed with droved stone.

Ventilating flues will be carried up the inside of walls of stable, and be joined to the air-trunk communicating with the outside ventilators on top of roof, having openings, with iron valves, for regulating the ventilation.

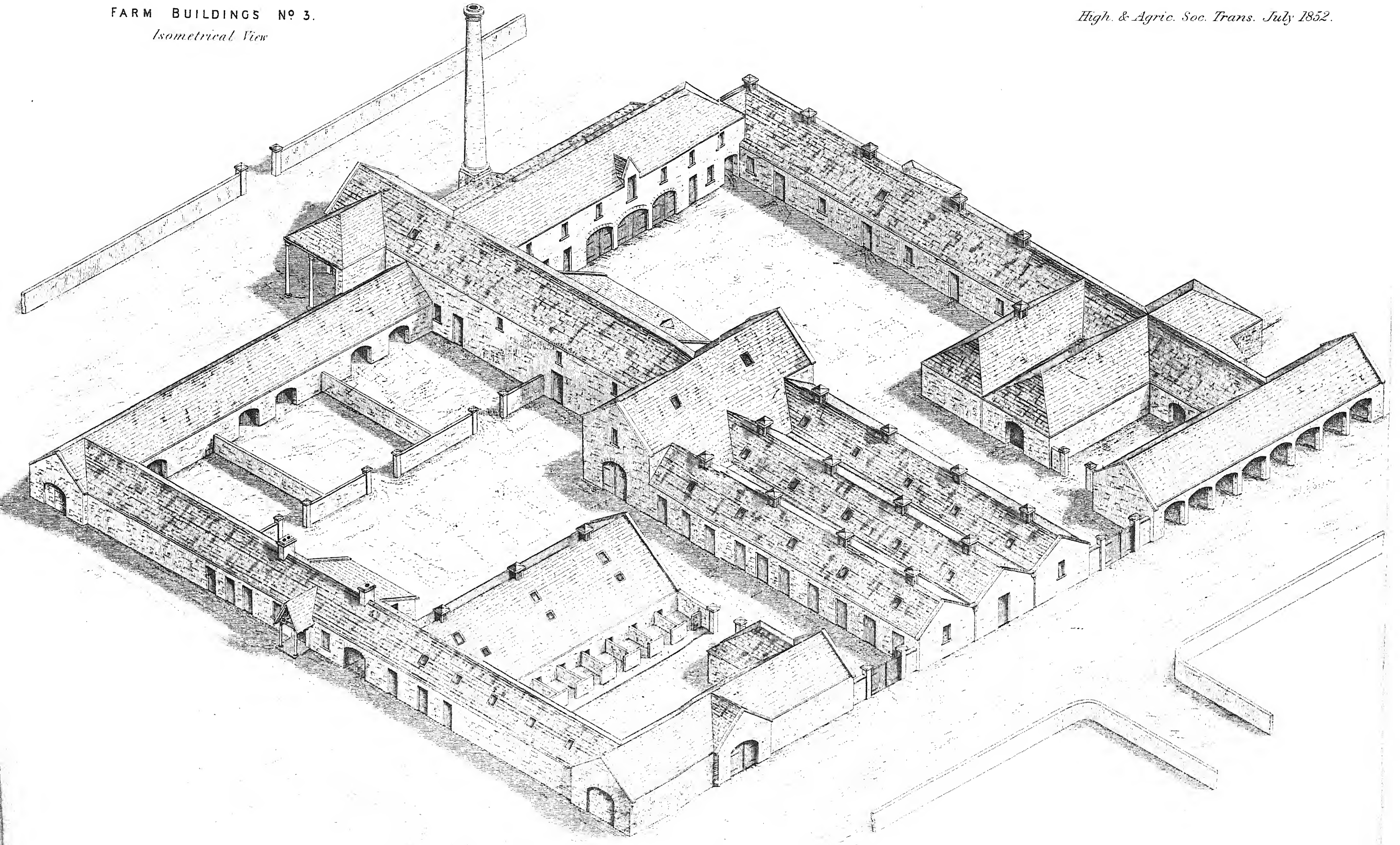
The floors of kitchen, scullery, and pantry, in bailiff's house,

PLATE VIII.

FARM BUILDINGS No. 3.

Isometrical View

High. & Agric. Soc. Trans. July 1852.



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EDINBURGH

and the floors of engine-house, boiler-house, steaming-house, poultry-houses, feeding passages in large byre, piggeries and calf-house, will be laid with pavement. The stalls in large feeding-byre and cow-byre will be laid with Forbes's patent drain pavement; and all other places (not requiring to be laid with pavement) will be laid with composition, or good causeway, as may best suit their respective places.

The safe lintels, where required, will be 1 inch in thickness for every foot of span, having 9 inches of wall-hold at each end, and be of the necessary breadths. The scantlings of main roofs will be $6\frac{1}{2}$ by $2\frac{1}{2}$ inches, placed 18 inches apart from centres, set on wall-plates 7 by $1\frac{1}{4}$ inches. The ties will be $6\frac{1}{2}$ by $2\frac{1}{2}$ inches, and the sarking $\frac{3}{4}$ of an inch thick, and not exceeding 10 inches broad.

The cast-iron pillars, for supporting roofs of feeding-byres, implement-shed, &c., will be 6 inches diameter at bottom. The beams over pillars will be 12 by 6 inches in feeding-byre; and those over implement-shed, and shed at corn-barn, will be double beams, each 12 by 6 inches, and bolted together with 1-inch bolts. The beams for supporting floors to be 12 by 6 inches, and will have 1 foot of wall-hold. The joisting for granaries, &c., where beams are used, will be 7 by $2\frac{1}{2}$ inches, all placed 18 inches apart from centres, and laid on wall-plates 7 by $1\frac{1}{4}$ inches. The bridling joists for stair will be 3 inches thick, and the same depth as joists. The joists will be covered with $1\frac{1}{4}$-inch grooved and tongued flooring. The two rooms in bailiff's house, and corn-barn, will have sleepers $6\frac{1}{2}$ by $2\frac{1}{2}$ inches, and 18 inches apart from centres, placed on sleeper walls, and covered with flooring, as above described; and each place having wood flooring will have a skirting-board 5 by $1\frac{1}{4}$ inches.

The exterior doors will be made of $1\frac{1}{4}$-inch grooved, tongued, and beaded deal, not exceeding 6 inches broad, (in two leaves where necessary,) having three strong back bars, and hung with strong crook and band hinges, and provided with proper locks or latches where required. Those for feeding-boxes to have a small ventilator in each. The interior doors will be of $\frac{3}{4}$-inch deal, executed in a similar manner.

The windows in bailiff's house will be cased, framed, and single hung, and glazed with second crown-glass. The windows in ground-floor, generally, will have fixed frames glazed with third crown-glass; those of stables will have opening boards one-third of the height from the bottom; and those in granaries, &c., will be filled with louvre boarding. The roof-lights will be of cast-iron, glazed with unfinished plate-glass.

The ventilators will be strongly framed up, and filled with louvre boarding on each side, and provided with the best description of apparatus for regulating the ventilation.

The inside stair in barn will be framed with strong stringers, the treads being $1\frac{1}{2}$ inches thick, and the breasts 1 inch thick.

The ceilings of bailiff's house, riding-horse stable, and harness-room, will be covered with good split lath; and these ceilings, together with the walls of bailiff's house, engine-house, corn-barn, granary, drying-room, riding-horse stable, and poultry-house, will have two coats of good plaster, well rubbed in; the ceiling of engine-house being arched with brick.

The heel-posts of stables will be 7 inches square, having a chamfer taken off the angles, and secured to a runtree at top, 7 by $2\frac{1}{2}$ inches. The travis-boards will be $1\frac{1}{2}$ inches thick, doweled on the joints, firmly fixed to heel and head posts, and have a cast-iron cape. The mangers will be of cast-iron, or wood lined with zinc, of the most improved form.

The harness-room will be lined on the walls with $\frac{5}{8}$-inch grooved, tongued, and beaded deal, on grounds; and both harness-room and stables will be fitted up with harness-pins, &c., complete. The corn-chests will be strongly framed up with $1\frac{1}{8}$-inch wood, and provided with hinged covers, &c., and have a conductor from the granary above.

The divisions of feeding-boxes in byre will consist of three strong rails, secured into the wall and to upright posts in front, and made movable. A strong rail will be placed along each side of the feeding-byre above the troughs, fixed to the divisions and cast-iron pillars.

The troughs in feeding-boxes, piggeries, calf-house, and sheds, will be made of $1\frac{1}{2}$-inch wood, strongly put together, and jointed with white lead; those in feeding-boxes being supported on movable bearers, and straw-racks will be placed above those in sheds.

The divisions in calf-house, and along the side of passage in piggery, will be fitted up with strong upright posts and sparred railing; and the feeding passage in piggeries will have swing-doors opposite the troughs for feeding.

The exterior gates and gates for courts will be framed and sparred in a substantial manner, hung with strong crook and band hinges, and have proper snecks or latches; those in the exterior having good locks, &c., complete.

All the exterior wood-work will receive three coats of good oil-paint.

The whole timber, where not otherwise specified, will be of good Memel timber, or red-wood plank and battens. The flooring deals and lining may be cut from white-wood battens. The finishings of bailiff's house will be of American yellow pine.

The ridges, piends, and valleys, will be covered with 5-lb. lead 14 inches broad, and the gutters will be laid with 6-lb. lead, having proper runs and drips. Flashings and aprons of 5-lb. lead where required.

A cast-iron cistern, to contain about 1500 gallons, will be placed adjoining the engine-house, from which ¾-inch pipes will be conveyed for supplying the feeding-troughs, &c., and for flushing the urine channels—having all the necessary nose-cocks, &c., complete. The large cistern will either be supplied from the clean-water tank by the force-pump, or by gravitation from an adjoining spring.

The roofs will have roans of 22 oz. zinc, and cast-iron conductors; the water being conveyed to the clean-water tank by drain-tubes.

The whole roofs will be covered with the best description of slating, the slates being procured from the best quarry.

A probable estimate has been made from the plans by an ordained surveyor, and computed to cost about £2800, exclusive of carriages, and on the supposition that the stones can be obtained from a quarry on the estate.

FINGER AND TOE IN TURNIPS.

THE following note, and relative list of queries, have been sent to the principal turnip districts; and the Directors now avail themselves of the Transactions to give them increased circulation, in the hope that farmers will readily communicate any information they may possess in reference to a subject of such importance:—

"HIGHLAND AND AGRICULTURAL SOCIETY,
EDINBURGH, 1st *June* 1852.

"SIR,—The Chemical Committee of the Society being desirous of investigating the subject of Finger and Toe in Turnips, the Directors have circulated the subjoined list of queries.

"It is intended that the answers shall apply, in so far as possible, to the results of the ensuing crop; but some of the questions embrace information derived from previous experience.

"The Directors trust that you will not only make your own returns as minute as possible, but induce your neighbours to communicate their observations also; for this purpose additional copies of the queries will be furnished by me if required. It is hoped that the schedules will be returned to me by the 1st of November next.—I am, Sir, your most obedient servant,

JN. HALL MAXWELL, *Secretary*.

"1. What is the variety of turnip affected?
2. What is the nature of the soil and course of cropping for the last seven years, and the rotation of cropping previously?

3. State the date of sowing, and the weather for two weeks before and after.
4. State the kinds and quantities of manures applied, time and mode of manuring, and condition of farm-yard dung.
5. State the date of first appearance of disease, and previous state of weather.
6. State extent of disease; if partial, can any reason be assigned?
7. Have insects been observed on the plant?
8. Has turnip been frequently cultivated on the same soil; state, if you can, how often, and at what intervals, and whether the land has recently lain any time in pasture?
9. If lime has been used, state how long since; to what crop; in what quantity; how applied; and the results.
10. Is the disease more prevalent where light manures have been applied, and has street dung had any effect on it?
11. Is the disease affected by the nature of the preceding crop?
12. Has the substitution of a potato or other green crop in the previous rotation rendered the land less liable to disease?
13. Is the land drained; and if so, in what manner?
14. Has the field been recently subsoiled or deep ploughed, and what is the average depth you plough for a green crop?
15. Have you observed any effect produced on the disease, either by working the land when rather wet in winter, or by working it much during dry weather in spring?
16. Have you observed any effect produced by rolling down the drills after sowing?
17. Have you observed any effect from applying the dung to the stubble in autumn instead of in the drill?
18. Have you observed the disease affected by hand or by hoe thinning, or by thinning early, or when the plant is strong?
19. Have you experienced any benefit from top-dressing the plants after being thinned?
20. Have you observed any difference on land which has been cut for hay and on land pastured, or on land pastured with sheep, and land pastured with cattle?
21. What variety of turnips has been most subject to disease; and whether does it prevail most among early or late sown turnips?
22. State any other observations on Finger and Toe that may occur to you."

On the DISINFECTANTS APPLICABLE in VETERINARY PRACTICE.*

By Mr James Collins, V. S., Birmingham.

Revised by Mr Finlay Dun, V. S., Lecturer on Materia Medica, Veterinary College, Edinburgh.

Disinfectants are of much service in arresting the development and extension of many diseases, but especially of those which are contagious or infectious—or, as they are popularly termed, *catching*. During the progress of such diseases, there is produced in the body of the sick animal a morbid matter, which appears capable of exciting in healthy animals a similar disease. The manner in which such morbid matter gives rise to disease is not, perhaps, as yet very satisfactorily ascertained; but the explanation first propounded by Liebig is now generally entertained both by chemists and pathologists. According to this very ingenious view, the contagious principle is believed to resemble those chemical substances which act as ferments—as yeast, rennet, &c. The former of these, when mixed even in a very small proportion with starch, soon converts it into alcohol with evolution of carbonic acid; whilst rennet, when added even in very small quantity to milk, causes very speedily a coagulation of the curd or casein. An effect analogous to that of these ferments is produced in the living body by many poisons, as by the saliva of animals affected by rabies, or by decomposing organic matter, as illustrated by dissecting-room wounds, &c.

Now, the poison of contagion appears to act in a similar manner to these ferments. Although often inappreciable in quantity, and not detectable by any ordinary methods of observation, it appears capable of causing great and rapid changes in the various tissues, both solid and fluid. These changes so alter the condition of parts as to interfere with healthy secretion and excretion, and thus disease occurs. In the case of many contagious diseases we have ample evidence of the transference of the (ferment or) morbid matter from sick to healthy animals, either directly or through the medium of *fomites*, (substances which absorb and retain contagion.) Glanders, for instance, is often caused, both in man and the horse, by the muco-purulent matter from the nostrils of a glandered horse coming in contact with a mucous surface, or the abraded skin. Mange and scab in sheep are often produced in previously healthy stock by contact with animals affected by

* This essay obtained the Society's medal in Dr George Wilson's class of chemistry at the Edinburgh Veterinary College. Another essay of equal merit, and for which a medal was also awarded, was written by Mr William Robertson, V.S., Dalkeith.

these diseases; and the same may be said of foot-rot and murrain —the latter of which is unfortunately, at present, very prevalent in various parts of Scotland.

But there are other diseases in which the influence of contagion is less obvious than in these. It has often, for example, been exceedingly difficult to trace the origin of cases of the pleuro-pneumonia epizootic, though in most cases this disease is distinctly contagious; but in this and in other diseases the contagion is probably more powerful and indestructible than is usually believed, and hence not only produces its effects without the necessity of actual contact between the sick and the healthy animals, but is capable of maintaining its powers unimpaired for a considerable time, and when diffused to great distances. Nor is the power of contagion always confined to weak and diseased animals; it often affects those previously in strong and vigorous health. From what has just been stated, it will be obvious that the disease-producing power of contagion varies almost indefinitely in its intensity in different diseases, and even in different cases of the same disease; but it is in all cases capable of being greatly modified, and even entirely deprived of its injurious tendencies; and we have now to notice by what means this may be best effected.

There are various ways by which contagious diseases may be deprived of their self-propagating power. The most effectual of these are—strict separation of the sick animals from the rest of the stock, from the first onset of the disease until convalescence is far advanced; thorough ventilation, so as to dilute the contagious poison with atmospheric air to such an extent as to render it innocuous; attention to cleanliness, and the removal of excrement, litter, and all substances capable of acting as *fomites*, to a distance from healthy animals; and the diligent and judicious use of disinfectants. The first three of these measures do not come within the scope of the present essay, in which we must restrict ourselves to the subject of disinfectants. In the prevention of contagious diseases, these are effectual chiefly in two ways:—1st, They mechanically absorb the contagious poison, whether gaseous, fluid, or solid; and, 2d, They chemically combine with or decompose it. All disinfectants act in one or other, or in both, of these two ways.

But disinfectants are advantageous not only in contagious but also in various other diseases, and in the *cure* of disease as well as in its prevention. They often combine the actions of deodorisers and of antiseptics, removing noisome odours, and preventing putrefaction, decay, and the evolution of gases injurious to health.

We shall now proceed to notice, *seriatim*, the various disinfectants applicable in veterinary practice; and, in compliance with the proposed subject, we shall discuss, as fully as our space permits, their mode of preparation, chemical composition, employ-

ment, and relative value. We shall notice first those which are chiefly mechanical in their action—as charcoal and lime; and afterwards those which are chiefly chemical in their action—as chlorine and sulphurous acid; and shall keep together all the substances which owe their action to the same or a similar ingredient.

Charcoal, as used in pharmacy and the arts, is of two varieties—vegetable and animal. Vegetable charcoal is prepared by the smothered combustion of various sorts of wood; animal charcoal, by subjecting animal matter—generally bones—to a similar process. Of the two varieties the latter is the more efficient as a deodoriser, as an antiseptic, and probably also as a disinfectant. It is capable of absorbing into its pores very large quantities of many different gases. It takes up about thirty-five times its volume of carbonic acid, and ninety times its volume of ammonia. From this great power of gaseous absorption, it is often useful for removing disagreeable odours, and counteracting contagious miasms. Before being used, it should be heated to low redness, and then scattered along the floors, and over the drains of stables and cow-houses, and, although its action is only mechanical, it proves a valuable adjunct to more active disinfectants, by keeping the atmosphere of such places pure and healthful.

Lime—or, as it is popularly termed, quick-lime—is often used for disinfecting purposes. It is obtained by the burning of carbonate of lime, (limestone,) and the consequent evolution of carbonic acid gas, and has a greyish-white earthy appearance, and an earthy astringent taste. It has a very strong affinity for moisture, and, when spread in the houses of animals, keeps the atmosphere dry, and hence prevents putrefaction and the evolution of those gases so deleterious to animal life. In solution it is also used for washing the walls of stables and such places, and, besides keeping them dry, gives them an agreeable, cleanly appearance.

Chlorine is a simple or elementary substance. At ordinary temperatures it is gaseous, of a greenish-yellow colour, possessed of intolerably suffocating properties, producing, even when inhaled to a small extent, violent coughing and irritation of the pulmonary mucous membrane. When pure chlorine gas is attempted to be inhaled, it causes sudden contraction of the glottis, and produces death from suffocation. If applied to the skin, it causes irritation, redness, and eruption. It is very soluble in water, which, at 60° Fahr., dissolves about twice its volume of the gas, and acquires its colour and odour. When such a solution is exposed to light, it is slowly changed into hydrochloric acid by the decomposition of the water, oxygen gas being given off. Chlorine gas has a specific gravity of 2.47. When exposed to a pressure equivalent to four atmospheres, it is condensed into a

yellow limpid liquid. It has little attraction for oxygen, its principal chemical affinity being exerted towards hydrogen and metals: many substances containing hydrogen take fire if brought in contact with it, a compound of hydrogen and chlorine (hydrochloric acid) being formed. This affinity for hydrogen confers upon it the power of decomposing sulphuretted hydrogen, hydrosulphuret of ammonia, and ammonia—the three chief gases evolved from putrefying organic matters, and to which they owe their disagreeable odours, and probably also in great part their deleterious effects on animal existence. Chlorine, however, is not only effectual in decomposing such gases as are evolved from putrefying matters, but also possesses antiseptic properties, in virtue of which it prevents farther decay. Another and a very important property of chlorine, and one for which it is largely used in the arts, is its bleaching power. It destroys most vegetable and animal colouring matters very speedily, as well as completely and permanently.

Chlorine may be generated by pouring any of the ordinary acids, as oil of vitriol, or strong vinegar, on chloride of lime, or commercial bleaching powder. The quantity of ingredients required will depend upon the size of the apartment. For one capable of holding six or eight horses or cattle, six or eight ounces (by weight) of chloride of lime, and the same quantity (by measure) of sulphuric acid, will suffice. The sulphuric acid should be diluted with half its measure of water, to which it should be added gradually, so as to prevent the evolution of too much heat. The chloride of lime should be placed in shallow earthenware or leaden vessels on the floor, in a central position, and the diluted acid poured upon it. Another, and a very cheap and simple way of preparing chlorine is, by pouring diluted sulphuric acid upon a mixture of common salt and black oxide of manganese. The gas is abundantly given off, sulphate of soda and sulphate of manganese being left. The quantity of materials to be used, in the same circumstances as before, is from four to six ounces of common salt, the same quantity of black oxide of manganese, and six or eight ounces, by measure, of sulphuric acid, diluted with half its measure of water. Chlorine can also be prepared by the action of hydrochloric acid on black oxide of manganese. This process is more expensive and troublesome than either of the others, and the gas is not given off abundantly, unless with the aid of heat.

There are few disinfectants more convenient and more powerful than chlorine. Its potent effect on colouring matter, and on most kinds of disagreeable odours, and its power of preserving organic matter from decay, are properties which go far to establish its character as an excellent disinfectant. But we have still more decided evidence of its value in the extensive use made of it by medical men in hospitals and prisons, and during the prevalence

of most contagious epidemics. The most recent eminent writers on medicine and therapeutics also speak very highly of it. Professor Pereira, in his *Elements of Materia Medica*, third edition, says: "As a fumigating agent, *disinfectant*, and antiseptic, chlorine, I believe, stands unrivalled." There are, however, some cases, even of contagious diseases, in which the efficiency of chlorine, as a disinfectant, is more than doubtful. Chlorine fumigations are apparently useless in preventing the progress of cholera and erysipelas. In Moscow, chlorine was extensively tried, and found unavailing, nay, apparently injurious in cholera. "At the time," says Dr Abbers, "that the cholera hospital was filled with clouds of chlorine, then it was that the greatest number of the attendants were attacked. Some years ago, chlorine was tried at the small-pox hospital, with a view of arresting the progress of erysipelas; all offensive smell, as usual, was overcome, but the power of communicating the disease remained behind."—PEREIRA, *Op. Cit.* p. 371. Facts of such authenticity as these seem to show that in the case of some diseases the efficacy of chlorine to arrest contagion is not so certain as was at one time believed. But though an unfailing power of destroying all contagions cannot be claimed for it, still we cannot doubt its utility in arresting the progress of most contagions; and it certainly should not be set aside, even in the case of those diseases in which its benefits appear doubtful, until it be proved to be of no effect, or a more efficient substitute be found for it. When large quantities of chlorine gas are to be liberated in a stable or cow-house, certain precautionary measures must be adopted. All animals should be removed; for the gas, as has been above remarked, is apt, when inhaled in an undiluted state, to produce serious irritation of the respiratory mucous membrane: metallic articles, and everything on which the gas might exercise its bleaching properties, should also be removed. All doors, windows, and such other openings should be closed, so as to prevent the escape of the gas; but, nevertheless, as much light as possible should be admitted, since the action of the chlorine is thereby greatly accelerated. These measures being adopted, the place should be kept full of chlorine for several hours, but must of course be freely ventilated before animals are again placed in it.

Chlorine water, when freshly prepared, may often be usefully employed as a disinfectant. It is got by saturating water with chlorine gas, obtained by any of the methods above noticed. Water, at the temperature of 60° F., dissolves twice its volume, and acquires the odour, taste, and other properties of the gas. In using this solution, it is either sprinkled over the floors, walls, mangers, and other parts of the building and furniture, or cloths saturated with it are suspended from various parts of the roof.

By the action of the atmosphere, the chlorine is gradually liberated. The chief disadvantage of chlorine water is, that when kept, especially if exposed to sunlight, it is extremely liable to undergo a change, which is brought about by the chlorine uniting with the hydrogen of the water.

Chloride of lime, or bleaching powder, is one of the most convenient and most commonly used of all the compounds of chlorine. It is prepared by exposing slightly moistened slaked lime to chlorine gas, which is rapidly absorbed. During this operation the chlorine should not be added too rapidly, nor should the temperature be too high. Chloride of lime is a soft white powder, having a distinct odour of chlorine, or more correctly of hypochlorous acid. It has a great affinity for moisture, is soluble in about ten parts of water, and, when dissolved, leaves a residue of hydrate of lime. The amount of chlorine obtainable from commercial chloride of lime is very variable; but when it has been carefully prepared, it should yield at least thirty per cent. The precise condition in which chlorine exists in this compound is not, as yet, clearly ascertained. Some believe it to be a compound of chlorine and oxide of lime; but most consider it as a mixture of hypochlorite of lime and chloride of calcium. But whatever be the exact composition of chloride of lime, certain it is that it possesses in a marked degree all the properties of chlorine. It decomposes sulphuretted hydrogen, hydrosulphuret of ammonia, and also ammonia; it neutralises carbonic acid, and absorbs moisture; arrests the putrefaction of animal and vegetable substances; destroys effectually fetid and unhealthy odours; and is, in the great majority of cases, a convenient and effectual disinfectant. Being now extensively prepared for bleaching and various other purposes, it can always be obtained at a very moderate cost. There are various ways of using chloride of lime as a disinfectant. When an acid is poured on it, copious fumes of chlorine gas are evolved. When used in this way, the precautions recommended in the case of chlorine itself must be attended to. Another, and in general a more convenient way of using chloride of lime as a disinfectant, is in the state of a watery solution. This may be made of any strength to suit the circumstances. It may either be sprinkled over the apartment, or exposed in shallow vessels, or cloths saturated with it may be hung in suitable situations. The carbonic acid of the atmosphere, by combining with the lime, causes a gradual evolution of the chlorine. When thus liberated, slowly and in limited quantity, there is no necessity for removing the horses or cattle. We believe that, even when no disease is prevalent, chlorine should be used in this way much more generally than it is, and that its employment, at short stated intervals, in stables, byres, and such other places, would be greatly conducive to the health and comfort of the inmates.

Chloride of soda is the active constituent of two well-known disinfectant solutions—*Labarraque's disinfecting liquor*, and *Fincham's disinfecting liquor*. The usual process for preparing it is as follows:—Take of carbonate of soda, 1 lb.; distilled water, 48 fluid ounces; chloride of sodium, 4 fluid ounces; binoxide of manganese, 3 ounces; sulphuric acid, 4 ounces. After powdering the chloride of sodium and the oxide of manganese, put them into a retort, and add the acid previously diluted with 3 fluid ounces of the water and allowed to cool. Heat the retort, and pass the chlorine first through 5 fluid ounces of water, and then into the solution of carbonate of soda. The change here occurring is somewhat complex, and the precise composition of the resulting compound has not yet been determined. The most recent and generally received view, however, is that it consists of one equivalent of hypochlorite of soda, one equivalent of chloride of sodium, and two equivalents of bicarbonate of soda. The solution is colourless, has an astringent taste, and an odour of chlorine. It may be employed in the same manner, and for the same purposes, as chloride of lime, and like it its efficacy depends chiefly upon its power of liberating chlorine. Although chloride of soda is more expensive and less generally used than chloride of lime, still some prefer it, especially when an antiseptic as well as a disinfectant action is required. This preference depends on the fact that when chloride of soda is used, chloride of sodium or common salt remains, which is more potent in preventing putrefaction than chloride of calcium, which remains when chloride of lime is used. We believe, however, that except when specially used as an antiseptic, this advantage of chloride of soda will be more than counterbalanced by the greater cheapness of the chloride of lime.

The solution of the *chloride of zinc*, better known as *Sir William Burnett's disinfecting fluid*, is largely used by many practitioners, and is strongly recommended by the Admiralty authorities. It may be prepared by heating metallic zinc in chlorine; by distilling a mixture of zinc filings and corrosive sublimate; or, more easily, by dissolving zinc in hydrochloric acid. In the solid state it is white, translucent, and fusible; very soluble in water, and exceedingly diliquescent. It consists of one equivalent of chlorine and one of zinc. The solution sold as a disinfectant contains twenty-five grains of the chloride in one fluid drachm of water, is colourless and inodorous, but has an astringent taste and action. It is a powerful antiseptic, and is consequently much used for the preservation of anatomical specimens. Although it does not evolve any odour of chlorine, it is a powerful deodoriser. But, whilst readily decomposing hydrosulphuret of ammonia and ammonia, it has little effect on sulphuretted hydrogen; and, on this account, it cannot fail in some cases to be inferior, both as

a deodoriser, and probably also as a disinfectant to the chlorides of lime and of soda.

Sulphurous acid consists of one equivalent of sulphur and two of oxygen. It may be prepared in several different ways—by burning sulphur in air, or by deoxidising sulphuric acid by charcoal, copper, or mercury. The latter process yields the gas very pure, but is attended with considerable expense. The former is the more simple and economical. When sulphur is burned in air, 16 parts by weight of sulphur combine with 16 of oxygen, forming 32 of sulphurous acid. In the combination there is no condensation, and the gas is consequently very heavy. When first given off it appears as a dense smoke or vapour of a white colour; but, when collected and allowed to stand, it becomes colourless. It has the odour of burning brimstone, and does not support combustion or respiration, but is irritating, corrosive, and positively poisonous. It is very soluble in water, and bleaches colouring matter. The colour, however, is not permanently destroyed as by chlorine, but can be restored by neutralising the acid. Sulphurous acid is a powerful antiseptic, effectually preventing and arresting putrefaction and fermentation. As a deodoriser, it is, in most cases, at least as effectual as chlorine or any of its compounds, and is used in preference to them in many paper works and in other manufactories. Accurate experiments regarding its disinfectant powers are still much wanted; but, from its well-ascertained effects as a deodoriser and antiseptic, we have no hesitation in recommending it as a most valuable agent for preventing the spread of contagious diseases. We should, therefore, enjoin that it be repeatedly used in all places where animals suffering from any such diseases have been kept; that it be liberated in considerable quantity in the gaseous state; that solutions of it be sprinkled throughout the buildings; and that all rugs, horse-cloths, and other clothing, after being washed with soap and water, should be steeped for some time in diluted solutions of the acid. From the irritant and poisonous properties of the undiluted gas, precautions similar to those mentioned when speaking of chlorine must be attended to in using it.

Sulphite of soda, more correctly termed bisulphite of soda, consists of one equivalent of soda and two of sulphurous acid. It is prepared by passing well washed sulphurous acid gas through a solution of one part of crystallised carbonate of soda in two parts of water. The solution, as it cools, deposits crystals of the bisulphite of soda—a white salt, having an acid taste and reaction, and an odour of sulphurous acid. It has recently attracted much attention. As an antiseptic, it has been used abroad for injecting bodies intended for dissection. A few grains, when added to a pint or two of fermenting solution, very speedily stop the fermentation. It has been administered with eminent success in hoven and tympanitis, both in man and the lower animals, and

probably owes its efficacy in these cases to the same power which it exerts in arresting ordinary fermentation. It has as yet been little used as a disinfectant; but there is no doubt that if it were more generally known, it would be more extensively employed. In addition to its other advantages, it has that of cheapness; and, as it is now largely prepared for the dyer, it can be readily got in any quantity. It owes its disinfectant, as indeed all its other properties, to its containing sulphurous acid. It is, however, somewhat less powerful than the pure acid, its properties being so far neutralised by combination with the soda.

Nitric acid, also called aqua-fortis, when anhydrous, consists of one equivalent of nitrogen and five of oxygen. The acid met with in the shops is a solution of this body in water. When nitric acid is to be used as a disinfectant, the best way of preparing it is to pour oil of vitriol upon an equal quantity of nitrate of potash (saltpetre.) The ingredients should be in an earthenware vessel, which should be placed on a shovelful of hot sand. During this process the sulphuric acid unites with the potash of the saltpetre and liberates the nitric acid, which rises in vapour. Nitrate of soda serves the purpose equally well as nitrate of potash, and is somewhat cheaper and more economical. The quantity of the materials necessary for fumigating a building capable of conveniently holding six or eight horses or cattle is about two ounces (by weight) of the salt and the acid. The properties of nitric acid are well marked; it has an intensely sour acrid taste, quickly turns the skin yellow, and readily corrodes the skin and other animal tissues. It has a great affinity for water, oxidises most of the metals, dissolves the greater part of them, and, at the same time, undergoes decomposition, nitric oxide gas being given off, which, combining with the oxygen of the air, forms suffocating ruddy fumes of nitrous acid. The corrosive action of nitric acid depends upon its affinity for water, its oxidising both the carbon and hydrogen of the tissues, and so leading to the formation of carbonic acid and water, and its power of oxidising and subsequently combining with the mineral matter of the tissues. To this power of oxidation nitric acid owes not only its properties as an active corrosive, but also, in all probability, its value as a disinfectant. The matter of contagion containing, like all other organic matters, carbon and hydrogen when acted on by this oxidising force, is altered in its composition, and thus deprived of its injurious effects, if not entirely, at all events to a great extent. Conclusive experiments, however, are still wanted to show the exact value of this substance as a disinfectant in different diseases, and also its efficiency as compared with other disinfectants. In the present state of our knowledge of this acid, and from its powerful effects on organic matter, both as a deodoriser and a corrosive, we must consider it as one of the most potent disinfectants with which we are

acquainted. There are, however, some circumstances which materially impair its utility, and circumscribe its use. It is so irritant and corrosive that, unless largely diluted with atmospheric air, it cannot be safely respired either by man or by the lower animals, and they must consequently be removed from any building that is to be filled with its vapours; and farther, on account of its corroding effect on all metallic substances, such articles must also be removed.

In referring to the acid disinfectants, we cannot pass *hydrochloric* or *muriatic acid* without a short notice. It consists of one equivalent of chlorine and one of hydrogen, is prepared by the action of sulphuric acid on common salt, possesses all the characters of a strong mineral acid, has an acrid taste, a strong suffocating odour, similar to that of chlorine, and a corroding action on organised tissues. As a deodoriser and disinfectant, it is greatly inferior to chlorine, and some even deny altogether its power of destroying contagious miasmata. But from its undoubted effect in neutralising ammonia, and also from the chlorine it contains, we are disposed to believe that it possesses, although in a limited degree, the disinfectant properties of chlorine, and those compounds of it which we have already noticed.

Various metallic salts have been used as disinfectants. The *acetate* and *sesquichloride of iron*—the former constituting, it is believed, the active ingredient of Ellerman's deodorising fluid—are held in high repute by some. They cannot, however, be compared either with chlorine or sulphurous acid; while, apart from all considerations of efficiency, their cost precludes their general employment in veterinary practice. *Sulphate of iron* has also been recommended, and *sulphate of copper* has its advocates. Several of the *acetates of lead*, and also the *nitrate*, have found favour with many. The nitrate of lead, in the proportion of one drachm to an ounce of water, constitutes Ledoyen's disinfectant fluid—a useful deodoriser, though not yet proved to be possessed of any power as a disinfectant.

But besides chlorine and its compounds, the acids above noticed, and these metallic salts, there are also a good many other substances which used to be considered as disinfectants, and which are sometimes erroneously considered as such even at the present day. Ammonia, vinegar, camphor, various of the odorous gums and balsams, are examples of such substances. These, however, cannot be considered as deodorisers, and still less as disinfectants. They do not absorb or decompose either odorous or contagious principles, but, by diffusing their own strong and often agreeable flavour, they only render the presence of such noxious principles less appreciable. They are thus productive of far more harm than good, for they prevent many from perceiving the necessity for thorough ventilation and efficient deodorisers and disinfectants.

LIST OF PLOUGHING COMPETITIONS *reported to the Society since December* 1851.

District.	Date.	No. of Ploughs	Extent.	Time.	Amount of Premiums.	First Premium and Society's Medal Awarded to
ABERDEENSHIRE—						
Nether Mains of Monymusk ...	Jan. 28, 1852	25	Rate of 1 acre	in 10 hours	£3 1 6	John Mackie, farm-servant, Monymusk.
Newhills	Dec. 17, 1851	29	Rate of 1 acre	in 10 hours	5 0 0	William White, farm-servant, Waterton.
Strath of Tarland	Dec. 16, 1851	29	½ acre	in 4½ hours	6 10 0	Thomas M'Donald, farm-servant, Titabentie.
Wardend of Durris	Dec. 11, 1851	48	Rate of 1 acre	in 10 hours	5 0 0	Peter Christie, farm-servant, Quithlehead.
Wellhouse, Alford	Feb. 11, 1852	41	⅓ acre	in 4½ hours	4 8 0	James Dunn, Greystone.
Wester Leochell	Dec. 22, 1851	34	⅓ acre Scotch	in 4 hours	4 0 0	James Simpson, farm-servant, Tillyfour.
ARGYLESHIRE—						
Argyle and Knapdale Society, Ballimore	Feb. 27, 1852	20	Rate of 1 acre	in 10 hours	4 9 0	C. M'Dougall, Dunadd.
Cuilcharren, Barcaldine	Mar. 1, 1852	16¼		in 4 hours	3 0 0	Dugald M'Coll, Lochnell.
Soroba, Oban	Feb. 26, 1852	15¼		in 4 hours	3 0 0	Alex. Livingston, Lerags.
AYRSHIRE—						
Carrick Farmers' Soc., Drumshang	Feb. 18, 1852	52	1 rood Scotch	in 4 hours	3 12 6	James Craig, farm-servant, Beoch.
Galston Farmers' Society, Goatfoot	Feb. 10, 1852	29	Rate of 1 acre Sc.	in 16 hours	4 17 6	James Howie, Skerrington.
Grongar Farmers' Society, East Raws	Feb. 11, 1852	18	Rate of 1 acre	in 13 hours	3 9 0	Andrew Fleming, farm-servant, Rushaw.
Kilmarnock Farmers' Club, Struthers	Feb. 6, 1852	32	1 rood 6½ poles	in 4 h. 20 min.	4 17 6	Gilbert M'Call, farm-servant, Kaimshill.
Poteath, West Kilbride	Feb. 27, 1852	26	Rate of 1 acre	in 13 hours	4 0 0	Hugh Wilson, farm-servant, Boydston.
BANFFSHIRE—						
Whitefield, Forglen	Jan. 1, 1852	42	½ acre	in 4½ hours	5 18 0	James Ogg, Upper Cranna Beg.
BERWICKSHIRE—						
Billiemains, Buncle	Dec. 12, 1851	20	⅔ acre	in 5½ hours	5 10 0	William Crystal, farm-servant, Billiemains.
East of Berwickshire Farmers' Club, Broomdykes ...	Dec. 10, 1851	24	¾ acre	in 6 hours	5 7 6	John Hume, Whitesomehill.
Do. Harelaw	Dec. 4, 1851	18	¾ acre	in 6 hours	5 7 6	Robert Redpath, farm-servt., Chirnside Mill.
Do. Heughhead	Dec. 19, 1851	22	¾ acre	in 6 hours	5 7 6	Andw. Logan, farm-servt., Auchincraw Mains.
Lauderdale Society, West Mains	Dec. 27, 1851	24	½ acre	in 6 hours	4 15 0	Andrew Tofts, farm-servant, Addinston.
Thornidyke, Westruther	Jan. 24, 1852	22	¾ acre	in 6½ hours	3 7 0	Jn. Simpson, farm-servt., Westruther Mains.
Upper District of Lauderdale Society, Carfrae ...	Jan. 27, 1852	32	¾ acre	in 7½ hours	5 5 0	D. Hamilton, farm-servant, Easter Addinston.
BUTESHIRE—						
Bute Farmers' Society, Meikle Kilmory ...	Feb. 6, 1852	42	Rate of 1 acre	in 16 hours	7 6 0	Thomas Haig, Kilmory.

LIST OF PLOUGHING COMPETITIONS (*continued.*)

District.	Date.	No. of Ploughs	Extent.	Time.	Amount of Premiums.	First Premium and Society's Medal Awarded to
CAITHNESS-SHIRE—						
Rougil	Mar. 12, 1852	29	2 roods 14 poles	in 6 hours	£3 15 0	James Donaldson, farm-servant, Calder.
Upper Ackergill	Jan. 6, 1852	42	2 roods 12 poles	in 6 hours	3 15 0	Joseph Munro, farm-servant, Ackergill.
DUMBARTONSHIRE—						
Cumbernauld	Jan. 20, 1852	23	1 rood 30 falls	in 5 hours	4 17 6	John Jeffrey, farm-servant, Auchinkilns.
EDINBURGHSHIRE—						
Castleton, Parish of Temple ..	Dec. 12, 1851	29	1 rood 34 falls	in 5 hours	3 10 6	James Bruce, Yorkston.
Hartwood	Dec. 16, 1851	19	2 roods 20 poles	in 6 hrs. 40 m.	3 3 0	William Wight, Burngrange.
Newbattle Society, Lawfield ...	Jan. 6, 1852	25	½ acre	in 5 hours	4 10 0	George Rutherford, farm-servt., Lingerwood.
Redside	Jan. 10, 1852	25	½ acre	in 5½ hours	4 10 0	Thomas Kerr, farm-servt., Carrington Barns.
Rosewell Mains	Jan. 13, 1852	26	½ acre Scotch	in 6 hours	4 10 0	John Ovens, farm-servant, Kerkettle.
Smeaton	Jan. 3, 1852	50	½ acre	in 5 hours	3 7 6	Archibald Shearer, farm-servant, Whitehill.
Stobs, Parish of Borthwick ..	Dec. 19, 1851	23	Rate of 1 acre	in 10 hours	4 13 0	John Baillie, farm-servant, Halkerston.
Woolmet	Jan. 17, 1852	23	½ acre Scotch	in 8 hours	3 10 0	William Smith, farm-servant, Woolmet.
FIFESHIRE—						
Crossgates Society, Vantago ...	Dec. 18, 1851	19	½ acre	in 7 hours	3 3 0	John Bisset, farm-servant, Boreland.
Largo Society, Teuchats	Dec. 31, 1851	20	½ acre Scotch	in 5½ hours	3 0 6	William Latta, farm-servant, Teuchats.
Leslie Society, Pitkevy	Jan. 29, 1852	48	½ acre Scotch	in 6 hours	3 12 6	James Robertson, farm-servant, Strathendry.
INVERNESS-SHIRE—						
Inverness Farmers' Society, Balnapettack	Mar. 11, 1852	27	½ acre	in 5 hours	3 0 0	David Shaw, farm-servant, Culloden Cottage.
KINCARDINESHIRE—						
Fettercairn Farmers' Club, Pitnamoon	Dec. 6, 1851	62	⅓ acre Scotch	in 4 hours	5 0 0	Wm. Cobb, farm-servant, Mill of Kincardine.
Nigg	Jan. 24, 1852	27	Rate of 1 acre	in 10 hours	9 0 0	James Brown, farm-servant, North Loirston.
LANARKSHIRE—						
Avondale Farmers' Soc. High Crewburn	Feb. 27, 1852	28	Rate of 1 acre Sc.	in 16 hours	4 9 6	Thomas Semple, Three-Stones.
Shields, Parish of Govan ...	Jan. 22, 1852	17	Rate of 1 acre Sc.	in 16 hours	3 0 0	William Gardner, farm-servant, Fairfield.
Upper Aitkenhead	Jan. 20, 1852	17	Rate of 1 acre Sc.	in 17 hours	5 2 6	James Craig, Cleugh, Eastwood.
LINLITHGOWSHIRE—						
Broxburn	Dec. 22, 1851	64	½ acre Scotch	in 7½ hours	3 0 0	William Hunter, farm-servt., Hatton Mains.
NAIRNSHIRE—						
Achnabechin	Mar. 10, 1852	16	½ acre	in 4½ hours	3 5 0	Alexander M'Leod, farm-servt., Achanbecan.

LIST OF PLOUGHING COMPETITIONS (*continued.*)

District.	Date.	No. of Ploughs	Extent.	Time.	Amount of Premiums.	First Premium and Society's Medal Awarded to
ORKNEY—						
Balfour, Shapinshay	Mar. 6, 1852	19	$\frac{1}{2}$ acre	in 5 hours	£3 15 0	William Phimester, farm-servant, Westhill.
PEEBLESSHIRE—						
Drochill Castle, Parish of Newlands	Dec. 26, 1851	22	$\frac{1}{2}$ acre	in 6 hours	3 5 0	Robert Thomson, farm-servant, Noblehouse.
Paulswell, West Linton	Jan. 2, 1852	25	$\frac{1}{2}$ acre	in 5 hours	3 3 0	William Muir, farm-servant, Robinsland.
PERTHSHIRE—						
Acharn, Kenmore	Mar. 2, 1852	23	$\frac{1}{3}$ acre	in $3\frac{1}{2}$ hours	3 0 0	John M'Dougall, Kinigallen.
Ardoch Society, Glenbank ...	Feb. 23, 1852	20	Rate of 1 acre	in 14 hours	3 0 0	George Scott, farm-servant, Quioys.
Castle Menzies	Feb. 27, 1852	31	$\frac{1}{2}$ acre	in 5 hours	5 5 0	Alex. Small, farmer, Carse.
Dalchosnie	April 2, 1852	15	$\frac{1}{2}$ acre	in $7\frac{1}{2}$ hours	3 12 6	William Forbes, farm-servt., Castle Menzies.
Dunblane Farmers' Soc., Barbush	Mar. 2, 1852	21	Rate of 1 acre	in 13 hours	3 10 0	Matthew Lennox, Cullings.
Garth Home Farm	Mar. 8, 1852	16	$\frac{1}{2}$ acre	in 5 hours	3 3 0	Hugh M'Dougall, Balnacraig.
Glengarry and Glenerichty Farmers' Club, Auchlecks ...	Mar. 15, 1852	16	Rate of 1 acre	in 10 hours	3 17 6	John Robertson, farm-servant, Calvine.
Kinloch-Rannoch	Mar. 30, 1852	15	$\frac{1}{2}$ acre	in $6\frac{1}{2}$ hours	3 0 0	Robt. Haxton, farm-servt., Kinloch-Rannoch.
Muthil Society, Drumawhance ...	Feb. 18, 1852	22	Rate of 1 acre	in 13 hours	3 10 0	Robert Maxton, farm-servant, South Tor.
St Martin's Society, Rosemount	Dec. 11, 1851	26	$\frac{1}{2}$ acre	in 6 hours	5 0 0	James Imrie, Bogs of Melginch.
Streethouse, Killin	Mar. 12, 1852	25	$\frac{1}{2}$ acre	in 4 hours	3 0 0	Peter M'Donald, Streethouse.
Stronehavie, Moulin	Mar. 17, 1852	16	$\frac{1}{2}$ acre	in 6 hours	3 10 0	John Rattray, farmer, Cultatonie.
RENFREWSHIRE—						
Burnhouse, Mearns	Feb. 3, 1852	19	60 falls Scotch	in $6\frac{3}{4}$ hours	4 2 6	James Allison, junior, Malletsheugh.
ROXBURGHSHIRE—						
Melrose Farmers' Club, Gladswoode	Jan. 3, 1852	26	$\frac{1}{2}$ acre	in 5 hours	5 12 0	Robert Grieve, Middles.
Union Agricultural Society, Fairnington	Feb. 19, 1852	71	$\frac{3}{4}$ acre	in 6 hours	13 0 0	Andrew Ker, farm-servant, Cessford.
West Teviotdale Society, Denholm Mill	Jan. 19, 1852	32	$\frac{1}{2}$ acre	in $5\frac{1}{2}$ hours	6 7 6	Walter Bryden, farm-servant, Burnfoot.
STIRLINGSHIRE—						
Greenloaning	Mar. 10, 1852	29	$\frac{1}{3}$ acre Scotch	in 5 hours	7 0 0	William Muirhead, Pirnhall.
Logie and Lecropt Farmers' Society, Westhaugh ...	Feb. 18, 1852	18	Rate of 1 acre Sc.	in 16 hours	3 0 0	P. Morrison.
Plean Soc., Auchinbowie Home Farm	Jan. 28, 1852	15	Rate of 1 acre Sc.	in 16 hours	3 4 0	Robert Dawson, senior.
Polmaise and Stewarthall Society, Back of Muir	Jan. 6, 1852	20	$\frac{1}{2}$ acre Scotch	in 7 hours	3 7 6	Peter Buchanan, farm-servant, Greenyards.
Strathblane	Jan. 30, 1852	21	$\frac{1}{2}$ acre 21 yards	in 6 hrs. 45 m.	3 12 6	James Weir, farmer, Barrachan.

Employed in these Competitions—1707 Ploughs, 3414 Horses, and 1707 Ploughmen; and £273 and 1707 Medals were awarded in Premiums.

PROCEEDINGS IN THE LABORATORY.

By Thomas Anderson, M.D., Chemist to the Society.

NOTE ON THE ADULTERATION OF GUANO.

In a former number of the Transactions of the Society, I published a variety of facts regarding the adulteration of guano which had come under my notice at that time, and I supposed that I had then said enough to put farmers on their guard. Some facts, however, have recently come out, which lead me to suspect that adulterated guano is sold in Scotland to a much larger extent than is generally supposed. I say *sold* in Scotland; for, so far as my present information goes, I have no reason to suppose that the actual adulteration is practised here—all the cargoes which I have been able to trace having been imported from different parts of England, where the adulteration seems to be carried on in a wholesale manner.

The circumstances which induce me again to refer to the subject in the Transactions, arise mainly from a series of articles which have recently appeared in the *Gardeners' Chronicle* on low-priced guano. After pointing out (what ought to be familiar to every one) that no genuine Peruvian guano can be sold for under £9, 5s. per ton, the editor proceeds to refer to various cases in which guano has been adulterated, cautiously avoiding any imputations on individuals; and among others, he says, "We should not be surprised if a bad opinion were entertained of the cargo of the Pandora, Captain Jay, which loaded at the Mudhole Tier, and sailed for Berwick with 150 tons of guano in bulk."

The publication of this article caused great excitement in Berwickshire, and samples were sent to the Laboratory, both by the owners of the cargo and by different gentlemen who had purchased quantities of it. These analyses of portions from different parts of the cargo all showed large adulteration, although the extent of adulteration varied in different portions, as might be expected, from the difficulty, or almost impossibility, of making a perfectly uniform mixture on the large scale. I give the results of three of these analyses.

	No. I.	No. II.	No. III.
Water,	13.05	11.95	14.86
Organic matter and Ammoniacal salts,	35.32	25.00	22.84
Phosphates,	26.61	25.32	26.19
Sulphate of lime,	14.18	28.04	21.32
Carbonate of lime,	"	"	2.19
Alkaline salts,	6.27	3.80	6.55
Sand,	4.57	5.89	6.05
	100.00	100.00	100.00
Ammonia,	10.62	8.90	7.59

For comparison's sake, I give the analysis of a good Peruvian.

Water,	12.16
Organic matter and ammoniacal salts,	53.51
Phosphates,	21.89
Alkaline salts,	10.68
Sand,	1.76
	100.00
Ammonia,	17.50

It appears, then, that the adulterated article in this instance contains a quantity of sulphate of lime, or gypsum, varying in different parts of the cargo from 14 to 28 per cent. In consequence of this addition, the percentage of ammonia is depressed from 17.5, the proportion found in genuine Peruvian, to 10.62 and 7.59. On the other hand, the quantity of phosphates is *higher* in the adulterated than in the genuine guano; and about 5 or 6 per cent of sand is found, whereas the usual percentage is 1.5, and it rarely exceeds 2. It is obvious, from the increased percentage of phosphates in these samples, that they have been adulterated with some material rich in phosphates. Thus, for instance, in the second analysis, the amount of gypsum and sand which form the adulteration, amount together to about one-third of the whole guano; or, in other words, such a mixture would be produced by adding one ton of foreign matters to two tons of guano. In doing this, however, the percentage of phosphates would be reduced from 22, the normal quantity, to somewhere about 14 per cent. In this case, however, we find upwards of 25 per cent; and the necessary inference is, that out of that, 10 per cent have been added along with the other adulterating material. On considering the whole case, I am inclined to think that coprolites, either ground or dissolved in acid, have been employed to adulterate this guano. There is an article largely sold under the name of dissolved bones, which is really made from coprolites, and that I suspect to have been employed. Its composition varies very much, but the following analysis, which I select at random from a number made in the Laboratory, may serve to represent its usual ingredients:—

Water,	16.16
Organic matter,	14.54
Phosphates,	30.20
Sulphate of lime,	27.25
Carbonate of lime,	3.45
Sand,	8.40
	100.00
Ammonia,	1.29

Now, a mixture of equal weights of this substance, and of the Peruvian guano, of which I have given the analysis above, would have this composition:—

Water,	14.16
Organic matter,	34.04
Phosphates,	26.04
Sulphate of lime,	13.63
Carbonate of lime,	1.72
Alkaline salts,	5.33
Sand,	5.08
	100.00
Ammonia,	9.40

which bears a general resemblance to the adulterated samples. It is more than likely that the method of adulteration varies greatly, and that coprolites simply ground, and gypsum itself are used; at all events, the latter substance is always present in considerable quantity. Now, such dissolved coprolites as that of which I have given the analysis, can be produced at a cost of about £3 per ton, and gypsum can be bought for £1, 5s.; so that the depreciation in value is very great. But the adulterated guano was sold at £9, 10s.,—the price of the genuine article!

Recent experience has shown me that considerable quantities of this sort of adulterated guano are imported into Scotland, or at least that attempts are made to import it, which, I have no doubt, are sometimes checked by analysis, but often, I fear, escape, owing to the negligence of buyers. The importation takes place entirely at the small seaports, and no case, so far as I know, has occurred at Edinburgh; but a considerable number have occurred at other ports. In proof of this, I give here analyses which have been made in the Laboratory during this season from different places. I do not know whether or not the guanos analysed have been sold at the places mentioned, but they have been sent from there for analysis, and very likely the result may have prevented their sale; but, of course, I have no information on that point.

	Banff.	Arbroath.	Dunbar.	Brechin.	Montrose.*
Water,	11.72	15.40	13.10	13.60	13.31
Organic matter and ammoniacal salts,	36.28	35.35	26.23	26.63	22.94
Phosphates,	24.54	25 03	23.35	23.89	24.49
Sulphate of lime,	12.90	10.75	20.57	17.16	20.76
Carbonate of lime,	...	...	2.53	3.67	1.25
Alkaline salts,	11.29	8.16	6.49	7.11	5.45
Sand,	3.27	5.31	7.73	7.94	11.80
	100.00	100.00	100.00	100.00	100.00
Ammonia,	10.36	11.04	7.95	7.80	6.76

It would be easy to multiply these analyses, but those I have given will suffice to show how very prevalent the practice of adulteration is; and to impress upon the practical farmer the importance of taking every precaution in the purchase of an article upon which so much of his success depends.

* This sample was sent from Montrose, but had been imported into Dundee.

ON DRAINING.

By Mr Andrew Dowie, Factor, Blair-Adam, Kinross-shire.

[Premium—The Gold Medal.]

The property to which this report refers* is situated on the eastern slope of a hilly country, the altitude being from 400 to 700 feet above the level of the sea, the climate cold and moist, the soil and subsoil composed chiefly of cold clay and sandy till, mixed with stones, and of a very retentive nature, with patches of moss from 3 to 7 feet deep intervening. At an early period—viz., from thirty to fifty years ago—the late proprietor† expended large sums in making most substantial sunk fences, in cutting deep drains in the hollows and across the declivities of the fields, and in otherwise improving the estate. The drains were cut deep, particularly in the hollows, and filled with stones, and conduited in the bottom; many of them, being still in good order, serving as leaders for the thorough drains; and the sunk fences, also, are in general 6 feet deep, serving as excellent outfalls.

On the introduction of the Deanston system of draining, the proprietor was amongst the first in adopting it, and a considerable extent of drains was put in, at first filled with broken stones, and afterwards with horse-shoe drain-tile and wooden soles; but, as was then customary, none were cut deeper than 2½ feet, until within the last three years, when a different, and what I consider a more perfect system of drainage, was adopted; but before entering on the details of the mode followed out, I would first beg leave to offer a few remarks on what I look upon as the very *keystone* of all drainage—viz., Outfalls.

In commencing the drainage of a field, the first and most important step to be taken is to secure, at whatever cost, a proper and sufficient outfall, for on this depends, in a great measure, the success of the subsequent operations. However well parallel drains may be executed, if proper attention be not paid to the formation of the outfall, the probability will be that the money will be expended to little purpose.

It is no uncommon thing to observe an outfall led into a running stream or ditch, on a level with the bottom of it; consequently, during the winter floods, the outfall, as well as the small drains, are often for weeks together under back-water. What then can be expected, but that the drains will soon get choked up, and the water again find its way to the surface?

Attention to outfalls and mouths of leading drains is, in my opinion, far too little attended to, not only in their formation,

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* Blair-Adam, the property of Admiral Sir Charles Adam, Lord Lieutenant of the County of Kinross, and Governor of Greenwich Hospital.

† The late Right Honourable Lord Chief Commissioner Adam.

but afterwards in the total neglect of them, and not unfrequently in their being lost sight of altogether.

In draining a field, no expense ought to be spared in bringing forward a sufficient level, so as at all times to keep the outfall clear of back-water; and I would beg to suggest, that, on an estate where there is a considerable extent of drainage, the outfalls and leading drains ought to be put under the charge of an intelligent workman, who shall be furnished with a book containing a sketch of the outfalls and leading drains in each field, and these he ought to examine and clean out at least twice in the year—viz., in spring and autumn, and oftener when necessary.

With these few preliminary remarks, I shall now proceed to report on the drainage of this estate, carried on under my inspection and personal superintendence, containing the depth and distance of the drains, the expense, the nature of the soil and subsoil, &c., and also a comparison between the different kinds of drain-tiles in use.

The extent of the drainage having been considerable, I propose to select only four fields, as an average of the whole, and report on them separately; viz:—

No. 1	Field	contains	35	acres	imperial.
„ 2	do.	do.	17	do.	do.
„ 3	do.	do.	25	do.	do.
„ 4	do.	do.	20	do.	do.

With the exception of No. 1 field, it is not my intention to enter into a detail of the return on outlay, as I consider that the doing so comes more properly under the subject of the "Improvement of Waste Land." I shall therefore confine myself to the return from No. 1 field, which, as formerly stated, contains 35 statute acres, and is intersected by a small watercourse, with about an equal quantity of ground—viz., 17½ acres on each side of it.

The soil of the whole of No. 1 field consists chiefly of a few inches of black or peaty earth, the subsoil a close retentive cold clay or till, and previous to draining produced rushes and other coarse grasses.

This field was drained during the winter and spring of 1848, but as the opposite sides of the field were differently drained, both as to depth of drains and distance between them, and have also been under different modes of management since, I therefore propose to report on each side separately, and shall begin with the southern half, bounded on the north by the said watercourse, along the bank of which, and at the distance of 5 yards, a main drain was cut, 3 feet deep, into which the small drains were led. In the bottom of this main drain a sole was laid, and a conduit built, 8 inches wide, by 10 inches high, and filled up with small stones to within 16 inches of the surface. The small drains were cut 2½ feet deep, and 18 feet apart, and laid with

a wooden sole 5 inches broad, and three-eights of an inch in thickness, and a common horse-shoe drain-tile 3 by 2½ inches. The cost of this part of the field was as follows, viz :—

	£	s.	d.
To cutting, laying, and filling in 660 chains of drain 2½ feet deep, at 1s. 8d. per chain,	£55	0	0
To 36,400 drain-tiles, at 26s. 6d. per thousand, carriage included,	48	4	7
To wooden drain-soles, at 20s. per acre,	17	10	0
Cost of draining south half of No. 1 field,	£120	14	7
Being at the rate of, per acre,	£6	17	11½

CROP 1848.

		£	s.	d.
The field having been in oats the previous year, a second crop was taken after being drained, the ploughing and harrowing of which cost per acre,		0	10	0
Seed oats per acre,		0	12	6
Yearly rent per acre previous to improvement,		0	10	0
		£8	10	5½
Deduct produce of crop, being 4 quarters per acre, at 16s. per quarter,		3	4	0
Balance against improvement at Martinmas 1848,		£5	6	5½

N.B.—Straw allowed for cutting and thrashing.

CROP 1849.

	£	s.	d.
The field in summer fallow, cost of ploughing and harrowing per acre,	1	10	0
To 15 tons of manure per acre, at 4s. per ton,	3	0	0
To 100 bushels lime, at 6d. per bushel,	2	10	0
To grass seeds per acre, sown without a crop at Lammas 1849,	0	12	0
To yearly rent per acre previous to improvement,	0	10	0
Balance against improvement at Martinmas 1849,	£13	8	5½

CROP 1850.

		£	s.	d.
In hay, produce 2½ tons per acre, at £3, 10s. per ton,	£8 15 0			
Foggage, per acre,	0 5 0			
		£9	0	0
		£4	8	5½
To this balance falls to be added, for making hay per acre,		0	6	6
Yearly rent per acre previous to improvement,		0	10	0
Balance against improvement at Martinmas 1850,		£5	4	11½

CROP 1851.

		£	s.	d.
To this balance falls to be added, rent per acre previous to improvement,		£0	10	0
		5	14	11½
The field was sold by auction, for a second crop of hay, at, per acre,	£5 15 1			
Foggage, per acre,	0 5 0			
		£6	0	1
Balance in favour of improvement at Martinmas 1851,		£0	5	1½

The northern half of this field, as formerly stated, has been under different management in every respect. It is bounded on the south by the small water-course formerly alluded to, along

the northern bank of which, and 5 yards distant from it, the main drain was cut, 4 feet deep, and filled with stones, in the same manner as the one on the opposite bank, the small drains being led into it, which were cut 3½ feet deep, and 30 feet apart, laid also with a wooden sole and horse-shoe drain-tile. The cost of draining this portion of the field was as follows, viz.:—

To cutting, laying, and filling in 360 chains of drain 3½ feet deep, at 3s. per chain,	£54	0	0
To 21,600 drain-tiles, at 26s. 6d. per thousand, carriage included,	28	12	5
To wooden drain-soles, 20s. per acre,	17	10	0
Cost of draining north half of No. 1 field,	£100	2	5
Being at the rate of, per acre,	£5	14	5
Crop 1848.			
Add yearly rent per acre previous to improvement,	0	10	0
To 100 bushels of lime per acre, at 6d. per bushel, carriage included,	2	10	0
	£8	14	5
Deduct rent of field let for mowing crop 1848, at the yearly rent of £2, 13s. per acre,	2	13	0
Balance against improvement at Martinmas 1848,	£6	1	5
Crop 1849.			
Add yearly rent per acre previous to improvement,	0	10	0
	£6	11	5
Deduct yearly rent of field in hay,	2	13	0
Balance against improvement at Martinmas 1849,	£3	18	5
Crop 1850.			
Add yearly rent per acre previous to improvement,	0	10	0
	£4	8	5
Deduct yearly rent in hay,	2	13	0
Balance against improvement at Martinmas 1850,	£1	15	5
Crop 1851.			
Add yearly rent per acre previous to improvement,	0	10	0
	£2	5	5
Deduct yearly rent in hay,	2	13	0
Balance in favour of improvement at Martinmas 1851,	£0	7	7

I have thus shown that both portions of the field have, at the end of four years, fully repaid the whole of the outlay on the improvements, and, when let in pasture, will bring on an average 15s. yearly per acre of more rent than what it brought formerly.

In regard to the drainage of this field, it will be observed that the south division cost £20, 12s. 2d. more than the north. This sum might not only have been saved, but also a much more effectual drainage obtained, had the same plan been followed as was done in the north division.

In cutting the drains in the north part of the field, a thin bed

of gravel was gone through, at the depth of 3 feet from the surface, which completely secured the efficiency of the drainage; and had we stopped short at 2½ feet deep, the advantage of this gravel-bed would have been lost, and thereby a greater expenditure incurred, as well as a much less efficient drainage. The south part of the field, although the drains are only 18 feet apart, yet, from being only 2½ feet deep, the ground in rainy weather is much sooner wet, and longer in drying, than the north portion of the field, where the drains are 30 feet apart, but are 3½ feet deep. This, therefore, is a clear proof that deep drains, and widely separated, are not only cheaper, but much more efficient than shallow drains, however close together.

The horse-shoe drain-tile and wooden sole, with which the whole of No. 1 field is drained, have now stood the test of four years, and continue to run as well as when they were first put in; nor, except in one instance, has it ever been necessary to lift a single yard of drain, the exception being the giving way of a single drain-tile.

No. 2 field contains 17 statute acres, and has been in pasture for the last thirty years, and being of a retentive subsoil, it was very much overrun with rushes—so much so, that it was necessary to mow them every year, for the purpose of keeping them down. As the field is situated not far from the mansion-house, it was resolved to drain it effectually. The soil, as formerly stated, was very close and retentive, being a brown loam, the subsoil cold till, intermixed with stones.

The drainage of this field was begun in the end of 1848, and finished in spring 1849. The drains were cut 3½ feet deep, and 15 feet apart; and as the field was to be retained in pasture, the upper sod was kept entire, and laid aside, and, on filling in the drain, was replaced with the green side uppermost.

Two kinds of drain-tile were used in draining this field, the one the common horse-shoe tile, with a clay or tile sole, the other a 2-inch tubular pipe, with a flat side or sole—the former laid with the two ends of the drain-tile meeting on the middle of the sole, the latter laid end to end, without anything to connect them. The cost of the whole was as follows, viz.:—

To cutting, laying, and filling in 728 chains of drain 3½ feet deep, at 2s. per chain,	£72	16	0
To 21,000 open drain-tiles, with tile soles, at £1, 13s. per thousand, carriage included,	34	13	0
To 21,000 2-inch tubular pipe, with flat side, at 27s. 6d. per thousand, carriage included,	28	17	0
	£136	6	6

Being at the rate of £8, 0s. 4½d. per acre.

No main drains were required for this field, as the old drains,

formerly alluded to, were found to be in excellent order, and served as outlets.

Although I cannot give a correct report of the return on the outlay, yet, from the superior quality of the grass now produced, and from the extra quantity of stock kept, I can confidently state that the return is not less than from 13 to 15 per cent. The rushes are fast disappearing, and white clover and other grasses of fine quality are taking their place; and when once a top-dressing is applied, the pasture will be still further improved.

So far as I am able to judge, I consider this field to be well drained, although, in my opinion, had the drains been cut 4 feet deep, and 21 feet apart, the cost would not have been greater, and the drainage more effectual. In a subsoil of clay or till mixed with stones, such as this field is composed of, I find from observation that the deep drain draws better than the shallow one, in consequence of veins of sand being more frequently to be met with nearer the bottom than the surface.

With regard to the kinds of drain-tiles used in draining this field—viz., the common horse-shoe tile, with a tile sole, and the tubular pipe laid end to end—I am inclined to give the preference to the former. In no case has it been found necessary to lift any portion of drain laid with common tile and sole; but where the tubular pipe has been used, it has frequently been necessary, from the bursting of a drain, to examine what was wrong, when it was invariably found that the one end of a pipe had sunk or slipped past its neighbour. I am therefore decidedly of opinion that no pipe drain-tile, whether round or with a flat side or sole, ought to be laid without a collar; but on this I will enter more fully in a subsequent part of my report.

No. 3 field contains 25 acres, and has been under white crop for the last two years, having been trenched and drained during the winter of 1849 and spring of 1850. It is, however, my intention to confine myself to the drainage, and the effects of it on this field, simply remarking that the returns from both crops were quite satisfactory, yielding a clear return of upwards of 18 per cent on the outlay.

The soil of the greater part of this field, with the exception of 3 acres of moss, is a brown loam, the subsoil cold retentive clay mixed with stones, the whole being very wet and swampy, and nearly impassable at all seasons of the year, the pasture coarse and scanty, and the annual rent about 10s. per acre.

A hollow runs from east to west through the centre of the field, the land rising both to the north and south sides of the hollow. After securing a sufficient outfall by cutting a new water-course at the bottom of the field, a main drain was carried along the said hollow, cut 5, and in some places 6 feet deep, the bottom of the drain being mostly on the solid rock. Indeed, in some places the rock had to be cut out, so as to insure sufficient depth. This

main or leading drain was filled with stones. First a strong conduit was built, 12 inches wide and 16 inches high, and then filled with stones to within 16 inches of the top. Into this main drain the whole drainage of the field was led, emptying at one mouth, which in wet weather forms no inconsiderable discharge.

The small drains, which are all led into this main drain from north and south, were cut 4 feet deep, with the exception of the 3 acres of moss, in which the drains were cut 5 feet deep, in order to get through the moss. The distance between the drains is 7 yards, or 21 feet. The mossy part of the field was laid with wooden soles, 5 inches broad and three-eighths of an inch thick, and the drain-tile used was the common or horse-shoe tile, 3 by 2½ inches. The remainder of the field was laid with pipes, both round and flat-sided, and 2 inches in diameter, both kinds having collars, the round pipe having a round collar, and the flat-sided pipe a collar of the same shape; and where the bottom of a drain was soft, a wooden sole was also used. This field I consider to be the most perfectly drained of any one on the estate, No. 4 field excepted; and I do not hesitate to affirm that, although 2½ or even 3 feet drains had been put in only 12 feet apart, the land would never have been in the same state.

The reason of this is obvious from the depth of the drains, the last 6 inches being through sand and gravel. The moisture is completely removed, and in consequence the lands have acquired a firmness and solidity which never would have been the case had the drains been ebber, and ever so close: the plough now does its work with the greatest ease, the horses moving as steadily as if walking on old infield land, where formerly neither man or beast could approach. The following is the expense of the drainage of this field:—

To cutting, laying, and filling in 787 chains of drain, 4 feet deep, at 2s. per chain, ...	£78	14	0
To 5350 common drain-tiles, at 22s. per thousand, . .	5	17	8
Drain-soles for do., (wood,)	3	0	0
To 20,000 flat-sided 2-inch pipe-tiles, with collars, at 30s. per thousand, ...	30	0	0
To 20,000 round 2-inch pipe-tiles, with collars, at 28s. per thousand, ...	28	0	0
	£145	11	8

Being at the rate of £5, 16s. 5½d. per acre.

No. 4 field contains 20 acres, and in point of soil and subsoil is very similar to the former field, about 8 acres being moss, the soil of the remainder being a brown loam, the subsoil clay and till full of stones, the mossy part producing bent, ling, and other coarse grasses, the hard land being covered with rushes, and the annual rent 10s. per acre.

The whole field was drained and trenched during the winter of 1850, and spring 1851, and sown with oats, with 2 cwt. of guano per

acre applied. The crop turned out well; and although I cannot state the return positively, yet I am confident that it is not under 50 bushels per acre.

The drains on the mossy part of the field were cut 5 and 6 feet deep, and 21 feet apart, quite through the moss, into a bottom of sandy till, and laid with wooden soles and common drain-tiles; those on the hard land cut 4 feet deep, and 21 feet apart. The main drains were cut 6 feet deep, and in the moss were laid with a wooden sole 12 inches wide and three-fourths of an inch thick, and main-drain tiles 10 by 8 inches; the main drains through the hard land were filled with stones, in the same manner as No. 3 field. The small drains were laid with 1½-inch and 2-inch round pipe, and also 2-inch pipe, with flat side or sole, the whole with collars.

Although it is not customary to use collars with flat-sided pipes, the flat side being meant as a substitute for a sole, yet, having frequently experienced the disadvantage attending the laying of pipes end to end, without anything to connect them, I ordered collars to be made with flat sides, to suit the flat-sided pipe, and used in order to prevent the accidental stoppage of the drains by the pipes slipping past each other. The following is the cost of the drainage of this field, viz.:—

To cutting, laying, and filling in 650 chains of drain, 4 feet deep, at 1s. 9d. per chain,	£56	17	6
To 14,300 common drain-tiles, at 22s. per thousand,	15	14	7
To Drain soles for ditto, (wood,)	8	0	0
To 10,000 flat-sided 2-inch pipe, with collars, at 28s. per thousand,	14	0	0
To 7000 round 2-inch pipe-tile, with collars, at 26s. per thousand,	9	2	0
To 4500 round 1½-inch pipe, with collars, at 24s. per thousand,	5	8	0
	£109	2	1

Being at the rate of £5, 9s. 1d. per acre.

I have only further to observe, that the drainage of this field was in every respect as complete as that of No. 3 field. Not a drop of water is to be seen on it; and at present the horses and carts are going over it, removing the crop, where formerly it was impossible to cross at any season. In the several accounts for cutting, laying, and filling in the small drains, the cost of the main drains is included, and also that the length of the horse-shoe and pipe drain-tiles was 14 inches.

I have selected and reported on four fields on this estate, as I consider that they represent the average of the drainage—the drains varying from 2½ to 4 feet in depth, and from 15 to 30 feet apart. A very considerable extent of drains has also been put in by the tenant-farmers on the estate, from 3 to 4 feet deep, and from 15 to 24 feet apart—the tenants paying a per-centage on the outlay, and performing the carriages at their own cost.

It now only remains for me to submit the conclusions I have arrived at, so far as practical experience guides me, in regard to what I consider the proper depth which drains ought to be cut, as well as the distance between each; and also what I consider the best kind of drain-tile, keeping in view the expense, as well as the efficiency, of the kind most proper to be used.

It would now be a waste of words to discuss the question of shallow and deep draining, which I regard as having been already satisfactorily solved. The results on No. 1 field are a clear proof that drains cut 2½ feet deep are a waste of money, not serving the purpose intended; for, had the south half of this field been drained in the same manner as the north half, not only would the sum of £20, 12s. 2d. have been saved, but the field would have been much more effectively drained.

As formerly stated, the portion of the field with the 2½-feet drains is much sooner wet, and is longer in drying, than the opposite side of the field, where the drains are cut 3½ feet deep and 30 feet apart. Water is never seen on the one side, although the soil has never been broken up; but after a heavy fall of rain, it is no uncommon thing to observe water standing on the other side, although it has been broken up, summer fallowed, and is now after a crop of hay.

Before commencing the drainage of a field, I would recommend the sinking of a number of pits, and thereby ascertain the nature of the subsoil. It will generally be found that, in almost every clay or tilly subsoil, veins of sand and gravel are much more frequently to be found at from 3 to 4 feet than at 2½ feet deep. To this I have paid particular attention, and I have invariably found it to be the case. I have therefore, for the last two years, cut no drain less than 4 feet in depth, and generally 21 feet apart; and on no account would I recommend drains at that depth to be placed more than 30 feet apart, unless in a very open subsoil. No. 3 field is also a proof of the benefit of deep drains. Had the drains in it been cut only 3 feet deep, the drainage in a great measure would have been incomplete, the last foot having secured the drainage, from its being composed chiefly of veins of sand and gravel. I am therefore decidedly of opinion, that drains cut 4 feet deep, and from 21 to 27 feet apart, will never fail in securing a permanent and most effective drainage.

With regard to the main or leading drains on this estate, the greater part of them were cut wide, and from 6 to 12 inches deeper than the longitudinal drains, laid with a wooden sole across, except on rock; substantial built conduits, from 8 to 12 inches wide, and from 12 to 16 inches high, with a cover, and filled with small stones above to within 16 inches of the surface; and in moss, where stones cannot be so well applied, main-drain tiles of a large size were used—being 10 by 8 inches, with a wooden sole, 12 inches broad by 3-4ths of an inch thick.

The following are the kinds and prices of drain-tiles most in use in this district—viz., The open or horse-shoe drain-tile, 3 by $2\frac{1}{2}$ inches, with a clay or tile sole, costs 32s. per thousand. The same kind of drain-tile with a wooden sole, 5 inches broad and 3-8ths of an inch thick, about the same price. The drain-pipe, with a flat side or sole, 2 inches diameter, with a collar, costs 28s. per thousand. The 2-inch round pipe and collar, 26s., and the $1\frac{1}{2}$-inch round pipe, 24s. per thousand. I may also mention, that in 1851 I caused a quantity of socket drain-tiles to be made, the one end of which is formed like the wide end of a trumpet, the other rounded off so as to insert into the wide end; but not as yet having had a trial of them, I cannot say how they will answer. I am rather of opinion that they will not suit the purpose so well as the round pipe and collar; for in the event of one part of the bottom of a drain being softer than another, the weight above may press so as to cause the one end to lose the catch of the other. However, as no collar is required, the cost will be less.

Of the different kinds of drain-tiles in use, I prefer the round 2-inch, and $1\frac{1}{2}$-inch pipe with collar. They are not only cheaper than the other kinds, but they lie more secure, the pressure being equal from one end of a drain to the other. Round pipes with a flat side, I believe, never were intended to be laid with collars; nor did I ever see them used, except on this estate. It was in consequence of observing the ends occasionally slip past each other, that I ordered collars with flat sides to be made to suit them; but they are neither so easily laid, nor do they lie so well, as the round pipe and collar, and are also more expensive. I therefore cannot recommend them. The open horse-shoe drain-tile, with a tile sole, as well as with a wooden sole, in moss, if properly laid, makes an excellent running drain, only inferior to the round pipe with collar, which, so far as I am able to judge, is preferable to any other kind in use.

Main-drain tiles are used of all sizes, both open and round; but for main drains I prefer a well-built stone conduit, except in mossy soil, when I prefer the large open tile and wooden sole.

I now beg to state in a few words the conclusion I have come to, that no drain ought to be cut of less depth than 4 feet, nor wider apart than 30 feet, except where the subsoil is very open; that on most soils, 4 feet deep drains, placed from 21 to 27 feet apart, secure the most perfect drainage; and as regards the expense, drains so put in are as cheap, if not cheaper, than $2\frac{1}{2}$-feet drains placed 15 feet apart, in consequence of the saving on drain-tiles. And further, that the round $1\frac{1}{2}$ and 2 inch pipe, with a collar, are not only the cheapest, but also the best kind of drain-tiles in use.

In connection with the very important subject of drainage, I trust that it will not be considered out of place to take notice of

the very great exertions that have been made in this country, both by landlords and tenants, in removing superabundant moisture from the soil; and especially, during the last few years, a great stimulus has been given to drainage in consequence of the grant by Government for that purpose—a grant which has been of very great benefit to the country in general, and to the proprietors of the soil in particular.

But, irrespective of the Government grant, a landlord cannot expend money in any manner, where remuneration is more certain, than in improving his property by draining; and I cannot too strongly recommend the system adopted on this estate, as well as on many others, viz., for the landlord to advance the money for drainage, the tenant performing the carriages, and paying a percentage on the outlay. To landlord and tenant, I look upon the benefits arising from the adoption of this plan as mutual; to the landlord, in giving him an interest in seeing the drainage efficiently and permanently, as well as economically performed, and at the same time securing to him a fair return—generally 5 per cent—on his outlay; to the tenant, in husbanding his capital, and placing it in his power to apply it in manuring, liming, and otherwise improving his farm, as well as keeping up a sufficient stock of cattle and sheep.

It is well known to every one connected with the soil that undrained lands can never pay; on which account it often presses heavy on a tenant, when he is obliged to sink his capital in thorough-draining his farm. It therefore need not be wondered at if he does so in the easiest and cheapest manner, to serve his purpose during the currency of his lease, which is all he needs to care for. But in the landlord allowing such a system to be pursued, it is generally found that, on the commencement of a new lease, the same process has to be repeated, and the same expense incurred by a new tenant; whereas, had the landlord advanced the money, and the tenant paid a per-centage on the outlay, their interest in effecting a permanent drainage would have been identical; and, on a renewal of the lease, the landlord, in all probability, might look forward to at least 10 per cent of increase on his former rent. This, to my certain knowledge, is by no means uncommon.

In closing this short, and I fear but imperfect report, I would beg to repeat, that the formation of outfalls ought to be the primary object with every one who undertakes the drainage of land, which, if properly attended to, and with drains cut 4 feet deep, and from 21 to 27 feet apart, cut straight, even in the sides and bottom, and laid with 2-inch pipe-tile and collar, will, I am fully satisfied, secure a complete and effectual drainage. I, of course, do not mean to recommend the practice to be adopted as a uniform rule in every case—very much depending on the nature of the subsoil, in regulating the depth and distance between drains—

but I do not hesitate to affirm that the system of drainage I have recommended will be found applicable to nearly two-thirds of the undrained lands of this country.

On the COMPARATIVE ADVANTAGES of FIXED and PORTABLE STEAM-POWER, as APPLICABLE to the PURPOSES of a FARM.

By Mr James D. Ferguson, Bywell Castle, Newcastle-upon-Tyne, formerly Agricultural Engineer in Glasgow.

[Premium—The Medium Gold Medal.]

The writer, in stating his observations in reference to the comparative advantages of fixed and portable steam-power, as applicable to the purposes of a farm, believes he will best convey his opinion in respect to them by dividing this paper into four sections—viz.:

1. Steam applied to the plough.
2. Fixed steam-power applied to thrashing-machines, turnip and chaff cutters, &c.
3. Portable steam-power applied to do. do.
4. Portable horse-power applied to do. do.

Steam-power applied to the plough is, the writer believes, of very recent origin, and, so far as he is aware, the first attempt on a large scale was made some years ago in Lochar moss, near the town of Dumfries. On that occasion many thousands were witnesses of the exhibition, and the writer happened to be one of the number, whose opinion, like many others, in respect to the utility or general advantage of the steam-plough, was by no means favourable. There was evidence, certainly, of a curious and most ingenious piece of mechanism, not only in the engine and its connections, but in the working of the plough; which, however, went but a short way as compensation for the many defects which appeared in the working of both.

On the whole, it was the general opinion at the time that it did its work very imperfectly; and, in consequence of the many obstructions in the soil which it met with—the iron belt which pulled the plough being continually breaking, as well as other parts of the machinery, and, consequently, much time being lost and expense incurred in making repairs—it is the deliberate opinion of the writer that, except for large level tracts of moss or bog, or for large enclosures on extensive level or carse farms, where there are no obstructions in the soil to hinder the free working of the plough, it cannot be brought into general use for the majority of tenants, especially as the great weight of the engine, as well as its expense, will constantly operate to its disadvantage; for if the engine is

fixed in the middle, or at one end of the field, and the plough or ploughs pulled by flexible iron belts similar to the one exhibited near Dumfries, it (the engine) will necessarily be expensive, as it must of necessity be heavy to resist the lateral pressure; and if the engine is made to travel with or in company of the plough, which may be done on dry ground, two or probably three horse power would be expended in dragging the engine itself. All these would materially operate against its general application. In a district of country, however, where there are large enclosures and extensive carse farms comparatively level, of loamy or clayey soil, and no likelihood of the plough meeting with any formidable obstruction in the subsoil, a steam plough might, the writer is positive, be introduced, and advantageously employed, on the principle of the portable steam engine for thrashing, the proprietor of the engine and plough hiring them out from time to time to parties—he charging a certain amount per day or per acre, according to the quantity ploughed, the tenant affording fuel or not, as the case might be.

He would feel very sorry to discourage any invention, by which the labour of cultivation to the farmer would be cheapened; but as respects the application of steam to the working of the plough, he has, like many others, his doubts of its ever being of general advantage to the majority of tenants.

Steam-power, however, both fixed and portable, is and may further be of the greatest advantage to tenants, in driving thrashing-machines, chaff and turnip cutters, &c.; and first, in respect to *fixed* steam-power, which in the end (compared with a portable engine) is not only for farmers of moderate or large extent the cheapest, but steadiest and best. The writer believes himself to be in a position, if not satisfactorily to prove this, at least to give a very decided opinion in reference to it, more especially as it has been his lot not only to attend to various kinds of thrashing-machines driven by horse-power, as well as by fixed and portable steam-power, from a portable one driven by four horses, up to one of twelve-horse power worked by a high-pressure steam-engine, and not only had to feed these machines, but occasionally to attend in the corn barn, as well as to assist in bottling or taking away the straw. He therefore had the fullest opportunity, from several years' severe practical experience, of observing the advantage and disadvantage of these powers, when applied to thrashing-mills.

There can scarcely be two opinions in respect to fixed steam-power being decidedly the best for all corn farms of moderate extent—of say 100 acres or upwards; and his opinion is founded on the following observations: A high-pressure engine, of four-horse power, which is sufficient for a farm of 100 acres, can now be obtained, with boiler and connections, for £90; and although an engine-house, with a chimney of considerable elevation, is abso-

lutely necessary, yet the expense of all these, when compared with the inconvenience and disadvantage of a portable engine for a farm of the size stated, is actually not worthy of consideration. A fixed engine, under cover, is easily kept and attended to, at the rate of about 6d. per day for oil and grease, &c., and is, of course, perfectly steady in its movements when working; while a portable engine, on the contrary, is often the very reverse, being fixed on four wheels; and this of itself is of much importance to notice, and, at any rate, it is generally more expensive for maintenance in tear and wear, &c., and also for oil and grease, in consequence of its exposure to all weathers, being generally put down at the barn door while working.

It is always a matter of considerable importance to the industrious tenant, that he should have it in his power to turn his servants to some in-door work during stormy weather, when it may be improvident to send men and horses into the fields; but if he has a good thrashing-mill, and a fixed engine to drive it, he can never be at a loss in the winter season. He is then comparatively independent. He can get up his steam by daylight in a winter morning, and by thrashing a whole day at once, (as every good managing tenant should do, to save fuel in raising the steam,) he procures not only abundance of fodder for his stock, (which, if stored carefully, will keep fresh a considerable time,) but a large quantity of grain, which, if need be, he can store past, to meet a rising market.

The tenant, however, depending on a portable engine to drive his thrashing-mill, is often not in such a favourable position as his neighbour, having a fixed one of his own. These, in England, are generally kept by parties in the district, who hire them out to tenants at so much per day, or at the rate of so much per bushel, or other measure, according to the kind of corn or length of straw which is thrashed. The engine is generally of four or six horse-power, and is fixed on a carriage having four broad wheels. When a farmer requires the use of this engine, it is necessary that he give notice to the owner of it a few days before it is wanted, and then send two horses (sometimes three are necessary) to drag it the evening before it is wanted, or early on the morning it is to be at work, in order that there may be sufficient time to get up the steam. It is generally set down at the outside of the barn door, and the thrashing-mill driven by a long belt from the fly-wheel of the engine, put over the pulley or sheave of the drum. It is, however, a complaint almost universally made, that in consequence of the engine being fixed on a wheeled carriage, it works usually in a very unsteady manner; and it is not uncommon that derangement and breakage of the thrashing-mill takes place, as well as sometimes of the engine itself.

There are other serious objections to a portable steam-engine; and, first, the risk of fire by sparks flying about, (which can

scarcely be avoided, although some of them are encased in sheet iron); and this of itself is a great objection to its use. Another and serious complaint is, the great inconvenience a tenant is sometimes put to (especially when markets are looking up) in not getting the engine on the day he wants it; for if only one is kept in the district, (and in some districts two would not pay,) there is often such a demand for it, that four or five, and even sometimes six days' notice, require to be given before the use of it can be obtained; and it not unfrequently happens that, before a tenant can get his corn thrashed and ready for the market, grain has again fallen in price.

This the writer has sometimes noticed, and with regret observed the great hindrance it often was to the industrious tenant making the most of his corn crops when markets were rising, whereas, had he had a fixed engine of his own, as, in the opinion of the writer, every tenant possessing a corn farm of 100 acres and upwards should have, (if water, which is the cheapest of all power, cannot be obtained,) he would always be in a position to catch a favourable market for his grain, and this of itself would go far, even sometimes in one season, to counterbalance the rate of interest on the original price of the engine, and buildings connected with it, even although he should build them himself. The writer remembers at one time of a tenant (he having a farm of considerable extent, but no thrashing-mill) being disappointed in getting a portable horse-power gin and thrashing-machine at the time he required it, (and this, by the by, which is also hired out and conveyed from place to place, is ready for work in one half the time that is required for a steam-engine, considering the time that is necessary to get up the steam,) who set a few men to thrash out his corn by the primitive method of flails, rather than lose the opportunity of exposing his grain for sale at a favourable market.

The usual prices of fixed high-pressure steam-engines are as follows:—

One of	four-horse power,	with boiler	and connections,	will cost	£90
Do.	six	do.	do.	do.	110
Do.	eight	do.	do.	do.	130
Do.	ten	do.	do.	do.	150
Do.	twelve	do.	do.	do.	170

To build the engine-house chimney 40 feet in height, erect engine and boiler house of bricks, 20 feet in length by 14 in breadth, and set up the engine of any of the above, will be, allowing the materials to be brought or carted say ten miles, and the roof a slated one, about £130

A four-horse power fixed high-pressure steam-engine will thrash and dress with a good mill, in a day of eight hours, with 4 cwt. of the best coals, (or a cwt. for each horse-power,) from 250 to 320 bushels of wheat, if the crop is a good one, and reaped in fair condition.

A six-horse power, do. do., will thrash and dress in the same time, with 6 cwt. of coals, from 290 to 370 bushels of wheat.

An eight-horse power, do. do., will thrash and dress in the same time, with 8 cwt. of coals, from 330 to 420 bushels of wheat.

A ten-horse power, do. do., will thrash and dress in the same time, with 10 cwt. of coals, from 420 to 600 bushels of wheat; and

A twelve-horse power, do. do., will thrash and dress in eight hours, with about 12 cwt. of coals, from 600 to 800 bushels of wheat.

It may not, perhaps, be out of place to detail here the number of hands generally employed at this powerful mill of twelve-horse power when working, which was undoubtedly the best the writer ever saw for farm purposes, although there was nothing peculiar in its construction. The feeding rollers were 6 feet in length, and the shaker, (called a travelling shaker,) which was horizontal, sparred across, and 14 feet in length, had a peculiar tremulous motion given to it by machinery, which, when the straw was thrown on to it by two common revolving rake shakers, made the corn pass through it into the hopper of the fanners below, while the straw was moved along by the power of an endless chain, which revolved round cylinders at each end, and made it drop over the partition wall, 14 feet in height, that separated the corn from the straw barn. It was the lot of the writer often to feed this machine, which always wrought a day at a time, and which was exciting although severe work. The number of people required for the machine while thrashing, and to prepare the corn for the market at the same time, and put it into sacks, which was always done, was as follows—viz.:

One man to attend the engine—two and a half, and sometimes three hours, being generally required in the morning to get up the steam, if the coals were good.

One do. to feed the mill.

Two women to unloose the sheaves; one on each side of the feeder.

One man (sometimes a woman) to cast the stack.

Two lads to cart the corn from the stackyard, if the stack was at a distance. The upper floor of the barn being on a level with the stackyard, in the end of which was a coach-house door, loaded carts were run back to the feeding-board.

One man in the corn barn; generally the steward.

Three women in do. do., a pair of hand-dressing fanners being kept going.

Two men taking away the straw. If bottled, four were required.

Two women building and trampling the straw in the end of straw barn.

The prices of portable steam-engines, with carriages, are as follows—viz.:

A four-horse power portable steam-engine, on a carriage with four broad wheels, will cost £220; and with a thrashing-mill and shaker attached, but without fanners, £55 additional.

A six-horse power do. do. do., £250; and with a thrashing-mill and shaker attached, but without fanners, £63 additional.

The writer has not seen any of greater power than the above, which in England are dragged about the country; but it is not uncommon that a thrashing-mill is conveyed from place to place along with the engine, the whole belonging to one person, who hires them out from time to time. When this is the case, the thrashing-mill, which is also fixed on a carriage, is run back into the barn, which in many parts in England is built of wood, and has generally a large door on each side, and when made steady on the floor, is driven by a long belt from the fly-wheel of the engine, which is planted at the outside of the door. Sometimes the thrashing-mill has a pair of dressing fanners attached, but oftener the corn is only thrashed; and sometimes a farmer has a fixed thrashing-mill of his own so constructed, with, and sometimes without fanners, that the engine which he hires to drive it can be easily attached to the sheave or pulley of the drum, and driven by a belt.

A four-horse power portable engine will thrash in eight hours, with a good mill, from 240 to 300 imperial bushels of wheat, if well got, or nearly as much as a fixed engine; but, generally, the portable machines, as before observed, are not so steady as those fixed, and consequently do not do so much work.

A six-horse power portable engine, with a good mill, will thrash in eight hours from 270 to 350 bushels of wheat, if a good crop, and reaped in fair condition.

The prices paid for the hire of portable steam-power thrashing machines are:—The hire of a four-horse power engine with thrashing-mill, runs generally from 10s. to 20s. per day, if only a few hours of it are required, and according to the state and condition of the crop to be thrashed, and sometimes 1d. per bushel is paid if two days' thrashing are required; but, in the latter case, the owner of the engine and mill, whose duty is generally to attend the engine, affords or supplies a man to feed the mill, and the farmer finds fuel for the engine.

The hire of a six-horse power engine and thrashing-mill runs from 15s. to 25s. per day, or according to the length of time the engine is working; but the price of 1d., and sometimes as high as 1½d. per bushel, is more frequently the arrangement made with the owner of the engine.

The party hiring is generally at the expense of carting the engine and mill to his steading when it is required; and in some districts it is common for the farmer last using them to send them with his horses to the next person hiring.

When the thrashing-mill is a fixture, and belonging to the farmer, as is the case in some places, the hire of an engine is then only required, and in that case the price paid for its use is, of course, proportionally less than when both engine and mill are required.

The prices of portable horse-power thrashing machines are:—A portable horse-power thrashing machine, with gin for two horses, including price of the carriage on which they are conveyed, the mill thrashing the corn merely, will cost £60.

A four-horse do. do. will cost £82.

A six-horse do. do. will cost £95.

A two-horse power machine will thrash in a day of eight hours from 150 to 240 bushels of wheat, according to the condition in which the crop has been reaped.

A four-horse power machine will thrash in the same time from 210 to 300 bushels of wheat, according to the condition in which the crop has been reaped.

A six-horse power machine will thrash in the same time from 260 to 350 bushels of wheat, according to the condition in which the crop has been reaped.

The prices paid for the hire of portable horse-power machines with horse gin are:—The hire of a two-horse power thrashing machine with gin for two horses, (the horses belonging to the party hiring,) runs from 10s. to 15s. per day; but oftener 1d. per bushel is paid for the quantity thrashed, and sometimes more, according to bargain, the owner of the machine feeding it, and the farmer affording a man or boy to drive the horses.

The hire of a four or six horse power machine and gin is proportionally more, and runs generally (but much depends on the state or condition of the corn to be thrashed) from 12s. to 16s. or 18s. per day, or 1d., and even sometimes 1½d., per bushel, the owner invariably feeding the machine, and the farmer supplying the horses and other hands for the work, as well as in conveying the machine and gin to the next person requiring them.

The writer has known in some districts the owner of the gin and thrashing machine keeping two, three, or four horses of his own for conveying it and the gin from place to place, as well as for working it; but when this was the case, the charge was, of course, considerably increased—generally 4s. per day for each horse—in addition to the charge per bushel for what was thrashed, and that over and above feeding the horses, which devolved on the party hiring. This, however, is only in districts where the farmers generally are unwilling to allow their horses to be put into a horse gin for thrashing, which they justly reckon very severe for them; consequently fixed steam-power is now becoming general, especially in good agricultural districts, where coals for fuel can be had at a reasonable rate; for the farmers begin to find, that when an engine is employed for thrashing, chaff and turnip cutting

machines and corn bruisers, &c., can at the same time be driven by it, as well as a pump in a urine tank for irrigation, about which a great deal of late has been said and written.

ON THE GROWTH OF TUSSAC GRASS.

By Mr JAMES RITCHIE, C. E., Perth.

[Premium—The Medium Gold Medal.]

GREATER diversity of soil is rarely to be found, within an equal area, than that exhibited in some districts of the Hebrides and western coasts of Scotland.

In the island of Lewis the arable lands are partly composed of fertile argillaceous loams and rich clays—one field of which, at the northern extremity of the island, is nearly 600 acres in extent—but are principally of peat earth, and a silicious loam, formed by a combination of peat and the debris of gneiss and porphyritic granite—the mildness and moisture of the climate tending greatly to facilitate the gradual disintegration of those rocks, the prevalence of which forms the chief geological characteristic of the island.

In the Lewis, however, and also throughout the Hebrides generally, and the adjacent coasts of the Mainland, the extent of arable land bears but a minute proportion to the total area. Much of the uncultivated land consists of peat or bog, which cannot profitably be brought into cultivation. But indeed past experience has established the fact, the truth of which the present position and future prospects of agriculturists seem more fully to confirm, that in these localities, to farm profitably, the growth of corn must always be subordinate and auxiliary to the cultivation of forage plants—cereal husbandry being more precarious, and less remunerative, in districts where the moisture of the climate is excessive, and where the autumnal gales are frequently violent and destructive.

It is, therefore, somewhat to be regretted that in many West Highland properties, where land has been extensively reclaimed for tillage, yielding returns so incommensurate with the expenditure, more has not been attempted in improving the herbage of the immense tracts of land unreclaimed and irreclaimable, by encouraging the growth of succulent and nutritious grasses, destroying coarse and noxious plants, or by introducing new grasses found to be valuable in a similar soil and climate.

Of the recently introduced gramineæ, the Tussac grass probably stands first in agricultural importance.

The Tussac grass (*Dactylis cæspitosa*) was introduced to Britain

in 1844. It is a hardy perennial forage grass, of the cock's-foot genus and fescue tribe. Referring to this grass in its most luxurious state of growth, as seen in the Falkland Islands, where it abounds, a graphic writer remarks:—"It is called Tussac grass from its roots being so densely matted together as to form a large tuft or *tussac*. These basal or columnar portions, formed by the close approximation of the stems or culms, often rise to a considerable height, from 4 to 6 feet. The long tapering leaves then diverge from them, and hang down all around, often in a very graceful curve, like the falling waters of a *jet d'eau*. The masses are insulated, generally a few feet apart, and the leaves, meeting above, form a kind of arched roof, beneath which the ground is generally quite bare of vegetation. A *tussac ground* thus forms a complete labyrinth, and a man may walk among its green arcades completely concealed from view."

Tussac grass was first introduced to the Lewis by the proprietor, Sir James Matheson, Bart., M.P., and sown under the direction of his chamberlain, Mr Scobie, in 1845.

In a letter to Sir James, Mr Scobie thus describes the method he adopted:—"The seeds which you sent me in 1844 were sown in the following spring in various parts of the island—viz., Coll, Holm, Linshaddir, Galson, &c. Of all these the two former were the only places where this valuable grass appeared; and of these two, Holm was the most successful and vigorous, being sown in a square plot of deep brown moss of medium dryness, close to the sea. The moss, scarcely yielding anything previous to its being turned over and enclosed, was delved over, and cut into small pieces with the spade, and the seeds sprinkled in, and roughly covered with a rake, and trampled in at the same time with the feet. The plants appeared during the following summer and harvest."

In the spring of 1847, a small peninsula on the farm of Holm, jutting out into the Minch, and extending in area to about 17 acres, was fenced off for a tussac ground. The soil is an intractable brown fibrous moss, varying from a few inches to 6 feet in depth, and resting on old red sandstone conglomerate.

At the same time, about 4 acres of this ground, comprising both deep and shallow moss, were drained and delved, and planted with tussac. The drains were chiefly of moss-wedge, and acted but indifferently, in consequence probably of defective construction—which, however, was in favour of the tussac, as a damp condition of soil seems best suited to its successful cultivation. The plants were dibbled into the moss in rows 3 feet 9 inches apart, each plant being the same distance apart in the row, or at the rate of about 3110 plants to the acre. After dibbling, a small quantity of guano mixed with earth was put into the hole before the plant, which was then secured in the ground in the usual way.

This field of tussac now presents a most luxuriant and flourish-

ing appearance, especially in the deep moss, and where most exposed to the sea; but where the moss is shallow, and over three rows which were planted without guano, the tufts, though healthy, are comparatively stunted, and have not attained to such exuberance of growth as the plants in the deeper soil, which rise to a height of from 3 to 4½ feet, the leaves measuring from 5 to 7 feet in length, and the rows overhanging and intermingling with each other, and forming a mass of herbage so dense that one can with difficulty force a way through it. The thickly-matted roots of the full-grown plants are from 12 to 18 inches in diameter, and they seldom penetrate deeper into the soil than 6 or 8 inches.

The whole of this field was cut in February 1851, and the grass consumed by cattle, except one small portion which was left uncut. No difference is now perceptible between that which was cut and the part that was left untouched, both being equally flourishing and vigorous, with the exception of some plants whose stems were partially injured by being cropped too closely to the roots. Two plants from the uncut portion were cut in May following, and found to weigh respectively 46 and 36 lb. The plant weighing 36 lb. was not one of the largest; but taking the average weight of each plant in the deep moss, where the growth is most luxuriant, at 30 lb., we have 3110 plants at 30 lb. each, which gives 41 tons as the aggregate weight per acre. The average weight per acre of the whole field, as nearly as can be ascertained, is 26 tons.

During the winter of 1849–50, the trenching of four additional acres of the same enclosure was commenced, part of which was planted in the manner already described in March 1850, while the moss was yet soft and fresh from the spade—a condition of soil which proved highly favourable, as, in the process of dibbling and planting, the trenched ground was broken and consolidated by the trampling of the people employed in the work, so that it remained unaffected by the dry and parching weather that set in immediately afterwards, and continued until the remainder of the space was trenched and planted in May following, by which time the last trenched moss had become hard and peaty, and more open and porous than is at all desirable for tussac cultivation. Both the early and late planted grass are healthy and thriving; but the part first planted would now afford five times the weight of fodder that could be procured from an equal extent of that planted in May, which, moreover, will in all probability be at least a year later in coming to maturity. This land was not drained. The grass was planted in rows 4 feet apart, the same space being left between the plants in the row. The plants were obtained by raising and dividing tufts from the old plantation, each tuft yielding from 40 to 60 good plants.

Tussac grass is eaten with avidity and much apparent relish by cattle. The soil best adapted to its cultivation appears to be a wet black moss; but it grows well in damp peaty soil of any

description. In the Falkland Islands, where it grows spontaneously, it is said to "flourish most vigorously in the rankest peat bog, black or red." The natural place of its growth is within 300 yards of the sea-shore, exposure to the spray and sea breeze appearing to be a condition essential to its prosperity.

As the soil must be damp no drainage is required, except such as may be effected by shallow open drains run into spots where there is danger of water stagnating or lying on the surface. Trenching may likewise be dispensed with. In preparing ground for planting, a turf 18 inches square may be cut for each plant, then inverted in the hole and cut to pieces with the spade, and the grass dibbled in as already described. In planting by this method, two men, working together, will cut the sods deeper than when only one man is employed. Moor land may in this manner be permanently planted out with tussac grass, at a cost of about 18s. per acre, exclusive of guano and fencing. A fence is indispensable, as cattle, when grazing at will, waste and trample the plants, and destroy the roots, by eating them too closely to the ground—preferring the root and lower part of the plant, because of the large proportion of saccharine matter which they contain. In most peaty soils, however, a sunk fence may be formed at little expense.

A part of the tussac ground at Holm was recently planted in this way; and there is every reason to believe that it will succeed as well as where the land has been regularly trenched.

Tussac should always be planted with a small quantity of guano mixed with earth, or some other stimulating manure, to sustain the young plant until its roots strike into the soil; after which, the alkaline substances which it assimilates from the driving spray and sea breeze, seem to be all that is required to bring it to perfection.

The tussac grass is an evergreen, and is uninjured by frost or snow. It bears planting out remarkably well, and is improved by cutting, if not cropped so closely to the root as to injure the stems. It may be cut in the second year, but it does not arrive at maturity until the third year of its growth.

The seed of the Holm tussac plantation was gathered in July 1850, and purchased by the Messrs Lawson of Edinburgh, none of it being sown in the Lewis. The field was again in seed in January 1851; but as it gave no promise of arriving at maturity, the grass was cut down for fodder. During the summer of 1851 no seeds whatever appeared; but immediately after the grass was cut—early in January 1852—it again began partially to "seed." It may be questionable whether it is quite judicious to cut strong grass, such as tussac, in winter, when it is coming to seed. I have seen no account of the season of its seeding in the Falkland Islands.

The economical value of the tussac grass is exhibited by the following analysis, given by Professor Johnston in the Transactions of the Highland Society for 1848:—

Composition of Tussac Grass grown in the Lewis, and collected in 1847.

			Dried at 330°.	
	Lower part.	Upper part.	Lower part.	Upper part.
Protein compounds,	2.47	4.79	17.81	19.38
Sugar, gum, and extractive matter, extracted by water,	3.32	3.64	23.88	8.93
Other nutritious substances, insoluble in water, but extracted by potash,	1.30	3.17	9.20	18.63
Woody fibre, (cellulose, with a little albumen,)	5.68	11.86	40.88	47.94
Saline matter, (ash,)	1.14	1.37	8.23	5.12
Water,	86.09	75.27		
	100.	100.	100.	100.

Referring to this analysis the Professor remarks :—"The first and most striking of the results contained in the third and fourth columns is, the large per-centage of protein, or muscle-forming ingredients. *These are as great as in the best samples of wheat, oats, or barley*, and show, therefore, that this grass is of a very nutritious character."

Three analyses of turnips are given by Professor Johnston in the Transactions of 1848, in which the average per-centage of water is 89.24. The per-centage of water in the tussac, as shown by the above analysis, is 86.09 : the tussac grass, therefore, contains less water, and consequently more solid nutritive matter, than the turnip.

Another sample of this grass from the Lewis, when dried at 212°, left of ash 6.29 per cent. The ash, when analysed by Professor Johnston, was found to consist of the following ingredients:—

Chloride of sodium,	12.21
Chloride of potassium,	36.01
Sulphate of potash,	14.34
Carbonate of potash,	14.16
Carbonate of lime,	4.42
Carbonate of magnesia,	0.41
Phosphate of magnesia, with a little phosphate of lime,	14.74
Phosphate of iron,	1.64
Silica,	3.09
	101.02

The growth of tussac grass has only been attempted, in the Lewis, near the sea-shore; but, when tried, it is probable that it may be found sufficiently profitable to warrant its cultivation at considerable distances inland. Chloride of sodium, (common salt,) obtained from the spray and sea breezes, being one of the chief constituents of tussac, an occasional top-dressing with salt has been recommended for inland plantations. The peculiar influences of the sea breeze, however, are not so soon exhausted as is commonly imagined. It has been observed that, during a continuance of gales, the leaves of trees and shrubs situated ten and twelve miles inland acquire a taste of salt.

As supplying winter food, and that of the most nutritious description, tussac grass is well worthy of the attention of stock farmers, who possess a soil suited to its growth, and who are now compelled to prosecute a limited, and therefore expensive, and unsatisfactory course of tillage, for the purpose of providing a small quantity of hay and turnip for winter use.

The great desideratum, likewise, in the agricultural economy of the crofters of the West Highlands and Islands, is an adequate supply of winter food for cattle, as the impoverished condition and attenuated appearance exhibited by their stock, when driven to the moors in spring, but too faithfully attest.

In those districts, therefore, the tussac grass must prove a most welcome and valuable addition to the present stock of forage plants; and, though it may be found amply remunerative under the garden culture, which it receives in some localities, its great value and importance is principally in consequence of its susceptibility of being grown to perfection in soils incapable of producing any other kind of herbage, and which, for ordinary agricultural purposes, are comparatively worthless.

ACCOUNT OF THE SHOW OF THE HIGHLAND AND AGRICULTURAL SOCIETY, HELD AT PERTH IN 1852.

The Show took place on the 3d, 4th, 5th, and 6th of August. Sixteen years had elapsed since the Society last met at Perth, and during such an interval it was reasonable to expect that much progress and improvement had taken place, and would be made apparent by the Exhibition of 1852. It is satisfactory to know that this anticipation was fully realised, whether as respects the quality of the stock, the variety and excellence of the implements, or the general extent of the show, compared with that of 1836.

The show-yard was erected on a portion of the South Inch, comprising about ten acres, which was placed at the disposal of the Society by the Lord Provost and Magistrates of the city. The Directors would avail themselves of this opportunity to express their thanks, not only for this act of liberality, but for the cordial countenance and co-operation extended to the Society throughout by the local authorities. It is further due to the contractor, Mr Falshaw, a member of the Society, to state, that on no former occasion were the works connected with the show-yard executed so entirely to the satisfaction of the Directors.

On Monday the 2d of August, the division of the yard set apart for implements and machinery was opened at an early hour for the reception of the different articles to be exhibited. With few exceptions, they were all placed before two o'clock on Tuesday, the hour fixed for the Judges to commence their duties. The Directors are gratified, therefore, that they have not to repeat the complaint made at Glasgow, of the inconvenience caused by exhibitors

neglecting the regulation as to time. They have further to report that there was no recurrence, to any extent, of the practice, so much condemned at Glasgow, of withholding implements which had been entered for exhibition, and inserted in the printed catalogue. With few, and perhaps unavoidable, exceptions all the articles entered for the Perth Show were duly forwarded.

On the afternoon of Tuesday, the ploughs, harrows, grubbers, rollers, &c., to be worked, were selected and transferred to the farm of Muirton, where the trial took place on the following morning, under the superintendence of Messrs Gibson, Woolmet; Harrop, Cairnies; and Steedman, Boghall; and in the presence of a large assemblage of agriculturists. The use of the ground was liberally allowed by Mr Morton, the tenant, who further provided the means not only of working the implements, but of conveying them to and from the field. It is due to Mr Morton to state, that he declined to accept any remuneration, either for his own trouble, or for the employment of his horses.

On Wednesday forenoon the yard was opened to the public for the inspection of the implements and dairy produce. In the afternoon an aggregate meeting was held of the Directors, and the Committees for the city and the counties of Perth, Fife, Kinross, Clackmannan, and West Forfar. His Grace the Duke of Athole, as chairman of the General Committee, presided; and arrangements were made to expedite the business of the following day, as explained by the Secretary. In the evening an address was delivered by the Society's chemist, Dr Anderson—his Grace the Duke of Roxburghe in the chair.

On Thursday morning the gates were opened for stock before five o'clock, when a numerous committee, under the charge of the Duke of Athole, so efficiently discharged the very onerous duty of arranging the animals in their respective pens, that above 1300 head were placed by seven o'clock, when the show-yard was cleared, and the Judges were allowed to proceed. Complaints are occasionally made of the regulation which requires the yard to be cleared; but the Directors are convinced of its propriety. It has now been in operation at three successive Shows; and there have been ample means of testing its utility, in enabling the Judges to discharge their duties without interruption, and free from the interference or remark of spectators. It need scarcely be remarked, that such a rule, while in existence, must be stringently enforced without regard to persons.

The doors were opened at ten o'clock, and, though the pressure was great—more particularly at twelve, when the charge was reduced to 1s.—the public were admitted without inconvenience or confusion. This important part of the arrangements was materially aided by the High Constables of Perth, for whose cooperation in superintending the gates and drawing the entrance-money the Directors felt very much indebted.

The banquet was held in the City Hall, which was granted by the Magistrates, and which is admirably adapted for such a purpose. The Duke of Roxburghe, as President of the Society, presided; and the Duke of Athole, as chairman of the local committee, officiated as croupier.

On Friday the usual exhibition of the prize stock and the auction were held; and the whole proceedings of the Show terminated with a trial of reaping machines. This took place on the farm of Muirton, where every assistance and facility were again given by Mr Morton, without putting the Society to any expense. The report of this trial will be found immediately following the details of the Show. It may be proper here to advert to a misunderstanding, and consequent disappointment to some, in reference to the trial of the reaping machines. Many persons attended at Muirton on Wednesday, under the idea that the reapers were to be worked that morning with the other implements; and their absence created an impression that the original arrangement had been departed from, and the trial postponed. For this, however, there was no ground. When the premiums were offered, no trial at Perth was contemplated; and the advertisement, which appeared repeatedly, contained the following note in reference to reaping machines:—"The award will not be made at the Show, as it will necessarily depend on the results of a trial which cannot take place till harvest; but parties intending to compete must exhibit their reaping machines at Perth, when the terms and conditions of the subsequent trial will be communicated." There could therefore have been no just cause of complaint, even had the trial been held in another place, and at a later period; but the Secretary, on his arrival at Perth on the 2d, finding the crops so far advanced, and that Mr Morton was willing to allow his to be cut on the 6th, anticipated the consent of the Directors, and, with the view of gratifying the public, made arrangements for a trial on that day, which was more than had been promised in the programme of the Show.

The Exhibition consisted of the following entries in the different classes of stock:—

CATTLE.

	Bulls.	Cows.	Heifers.	Oxen.	Total.
Short-horns, ...	47	15	20	...	83
Extra, ...	...	...	1	...	
Polled, ...	24	12	16	2	57
Extra, ...	...	1	1	1	
Ayrshire, ...	14	22	17	...	55
Extra, ...	...	...	2	...	
Highland, ...	18	13	21	12	82
Extra, ...	...	1	6	11	
Fifeshire, ...	5	5	4	...	14
	108	69	88	26	291

	Bulls.	Cows.	Heifers.	Oxen.	Total.
	108	69	88	26	291
Extra,					
Alderney,	1	...	...	...	1
Tuscany,	...	1	...	...	1
Orkney,	...	1	...	...	1
Crosses,	...	2	6	10	18
	109	73	94	36	312

HORSES.

	Stallions.	Entire Colts.	Mares.	Fillies.	Highland Pony Stallions or Mares.	Geldings.	Total.
Draught,	21	41	20	34	...	...	135
Extra,	2	...	...	3	9	5	
	23	41	20	37	9	5	

SHEEP.

	Tups.	Ewes.	Gimmers.	Lambs.	Wethers.	Total.
Leicester,	96	80	80	...	...	272
Extra,	5	2	2	7	...	
Cheviot,	71	15	40	...	...	126
Extra,	...	...	...	...	...	
Blackfaced,	33	25	50	...	...	124
Extra,	2	...	...	...	14	
Southdown,	30	50	35	...	...	120
Extra,	...	...	...	5	...	
Extra—						
Dorset,	...	5	...	...	...	5
Romney Marsh,	...	5	5	...	5	15
	237	182	212	12	19	662

SWINE.

	Boars.	Sows.	Pigs.	Total.
Large,	3	4	12	50
Small,	11	20		
	14	24	12	50

POULTRY.

Turkeys, Norfolk or Black Breed,	16
Other Breeds,	10
Capon Turkeys,	...
Fowls, Dorking Breed,	34
... Polish Breed,	2
... Spanish Breed,	10
... Hamburgh Breed,	8
... Old Scotch Breed,	6
... Malay Breed,	8
... Cochin China Breed,	20
... Other Breeds,	14
Capons,	...
Poulards,	2
Ducks, Aylesbury Breed,	18
... Other Breeds,	16
Geese,	22
Total,	186

DAIRY PRODUCE.

	Cured.	Powdered.	Fresh.	Totals.	
Butter,	30	21	28	79	
	Sweet milk.	Skimmed milk.	Imitation English.		
Cheese,	18	17	9	44	
					123

IMPLEMENTS.

Ploughs of all kinds,	26	Brought forward,	153	
Grubbers,	21	Hay-rakes and tedding machines,	6	
Harrows,	13	Thrashing machines,	6	
Rollers,	17	Dressing fanners,	4	
Swing-trees,	4	Weighing machines,	2	
Sowing machines,	18	Churns,	15	
Horse-hoes,	3	Cheese-presses,	6	
Liquid-manure machines,	2	Curd-cutters,	2	
Straw-cutters,	6	Field-gates,	7	
Turnip-cutters,	8	Travis divisions, rack and manger,	1	
Bruisers,	7	Farm-harness,	4	
Root-washers,	4	Drain tiles, pipes, and tools,	9	
Steaming apparatus,	2	Flax machinery,	2	
Troughs for feeding-byres,	2	Reaping machines,	6	
Farm-carts,	9			223
Stack-pillars,	11			
Carry forward,	153			

Extra entries,		40
General Collections.		
Lord Kinnaird, Rossie Priory,	20	
James Slight, Edinburgh,	16	
William Cadell, Sons, & Co., Cramond,	1	
Grangemouth Coal Co.,	2	
Richard Hodgson of Carham,	1	
John Wauchope of Edmonstone,	1	
Thomas Gorrie, Perth,	6	
Charles D. Young & Co., Edinburgh,	9	
Young, Peddie, & Co., Edinburgh,	20	
		76
Total,		339

ABSTRACT.

Cattle.	Horses.	Sheep.	Swine.	Poultry.	Dairy produce.	Implements.
312	135	662	50	186	123	339

Total head of Animals, ... 1345
Total number of Articles, ... 462

The following statement gives a comparative view of the Exhibition at Perth in 1836 and in 1852.

CATTLE.	Perth. 1836.		Perth. 1852	
Short-horns,	45		82	
Angus, Aberdeen, and Galloway Polled,	14		54	
Ayrshire,	33		53	
West Highland,	65		64	
Fife,	20		14	
Extra,	88		45	
		265		312
HORSES,		46		135
		311		447

SHEEP.	Perth. 1836.		Perth. 1852.	
Brought up,	311		447	
Leicester,	192		256	
Cheviot,	16		126	
Black-faced,	133		108	
Southdown,	...		115	
Extra,	75		57	
		727		1109
SWINE,		18		50
POULTRY,		...		186
DAIRY PRODUCE,		6		123
IMPLEMENTS,		17		339
		768		1807

PREMIUMS AWARDED.

CATTLE.

SHORT HORNS.

Judges.—Randle W. Saunders of Nunwick Hall, Penrith; Hugh Watson, Keillor, Forfarshire; and John Wilson, Edington Mains, Berwickshire. —*Attending Member*, His Grace the Duke of Roxburghe.

Sweepstakes for Short-horn Bulls—to Thomas Chrisp, Hawkhill, Alnwick.

For the best Bull of any age—twenty sovereigns, to Thomas Chrisp, Hawkhill, Alnwick.

The silver medal to Thomas Chrisp, as the *Breeder* of the best Bull.

For the best Bull, calved after 1st January 1850—ten sovereigns, to A. Cruickshank, Sittyton, Aberdeen.

For the best Bull, calved after 1st January 1851—six sovereigns, to His Grace the Duke of Buccleuch, Dalkeith Park.

For the best Cow of any age—ten sovereigns, to James Douglas, Athelstaneford, Haddington.

For the second best—five sovereigns, to William Tod, Elphinstone Tower, Tranent.

For the best Heifer, calved after 1st January 1850—eight sovereigns, to James Douglas, Athelstaneford, Haddington.

For the second best—four sovereigns, to James C. Grant Duff of Eden, Banff.

For the best Heifer, calved after the 1st January 1851—five sovereigns, to James Douglas, Athelstaneford, Haddington.

In the opinion of the Judges, the aged bulls were very superior to the younger. The former, on the whole, were good and useful animals, and some of them indicated marked merit. The young bulls, on the other hand, with the exception of the prize-takers and two or three more, were not exactly of that stamp which might have been looked for on such an occasion, or which could be with confidence expected to form the sires of superior stock. As a similar deficiency was observed at Glasgow in 1850, and as the improvement of the domesticated animals can only be successfully accomplished by the persevering use of males of better breeding than the females with which they are coupled, the Directors would impress on the attention of breeders the paramount importance of securing young bulls of the purest descent, and in the highest points of quality. If this rule be not rigidly adhered to, short-horns, while they increase in numbers, must inevitably retrograde in quality. It is

satisfactory to report that, in the female class of this breed, the younger surpassed the older animals, and that they were not only deserving of commendation as a lot, but presented excellent specimens of individual merit.

Notwithstanding the discouragement shown by the Society to over-feeding, the Directors regretted to observe the excessive state of fatness in which some of the animals were exhibited. The Society's Judges are specially instructed to withhold premiums from all over-fed bulls, cows, and heifers; and if it should appear that this intimation is insufficient to deter exhibitors from sending such animals in an unfit and improper state, other and more stringent means must be adopted to mark the opinion of the Society, by preventing their admission to its Shows.

POLLED CATTLE.

Judges.—Arthur Glennie, Ferniefiat, Kincardineshire; John Graham, yr. of Shaw, Dumfriesshire; George Milne, Haddo, Aberdeenshire.—*Attending Member*, Robert Stewart of Ardvorlich, Perthshire.

Sweepstakes for Polled Bulls, to Hugh Watson, Keillor, Coupar-Angus.

For the best Bull of any age—fifteen sovereigns, to Hugh Watson, Keillor, Coupar-Angus.

The silver medal—to Hugh Watson, Keillor, as the *breeder* of the best Bull.

For the best Bull, calved after 1st January 1850—eight sovereigns, to Alexander Bowie, Mains of Kelly, Arbroath.

For the best Bull, calved after 1st January 1851—five sovereigns, to Thomas Carnegy of Craigo, Montrose.

For the best Cow of any age—eight sovereigns, to William M'Combie, Tillyfour, Aberdeen.

For the second best—four sovereigns, to Hugh Watson, Keillor, Coupar-Angus.

For the best Heifer, calved after 1st January 1850—six sovereigns, to William M'Combie, Tillyfour, Aberdeen.

For the second best—three sovereigns, to William M'Combie, Tillyfour, Aberdeen.

For the best Heifer, calved after 1st January 1851—four sovereigns, to Robert Scott, Balwyllo, Brechin.

For the best pair of Oxen, calved after 1st January 1849—the medium gold medal, to William M'Combie, Tillyfour, Aberdeen.

For some years back the Angus and Aberdeen polled and the Galloway polled have been separately judged at the Society's Shows. On this occasion, however, the original practice of classing them together was reverted to. In doing so, the Directors conceived that it might be useful to bring these varieties, of what is essentially the same breed, into closer comparison, with the view of determining their respective qualities, and of ascertaining the points in which either is deficient, or where the one may gain by an intermixture with the other. The following observations, taken from the report of the Judge who attended from the Galloway district, induces the Directors to hope that their object has not been overlooked. That gentleman remarks that, as a general rule, Angus and Galloways would be better shown separately;

but he states, "I am rather of opinion it has been wisely judged in having the two breeds classed together at the Show, as it may turn the attention of breeders of Galloways more to the useful qualities of these animals—that is, in being more careful with regard to the softness of touch, which is the requisite for aptitude to fatten, instead of looking so much to the great length of hair, (without reference to its softness,) which, I think, is too much followed in this part of the country, to the exclusion of more useful qualities. I am of opinion that the Galloways may be much improved by judicious crossing with the Angus, though adapted to certain modes of farming for which the pure Angus would be too tender."

There was admittedly no comparison between the Galloways and the Angus or Aberdeens. It is right, however, to remark that, while the former were regarded as below an average of former Shows, the latter were perhaps never before surpassed in quality. In this breed, male and female of all ages exhibited superior merit, and many were splendid examples of individual excellence. The bull belonging to Mr Watson, Keillor, which carried the sweepstakes, was particularly reported by the Judges as an extraordinary animal, and unrivalled for strength, symmetry, and quality, though now fourteen years of age. In fact, he showed the perfection to which judgment and attention can bring this valuable breed. The Directors rejoice that this and preceding Shows indicate a praiseworthy amount of effort and care on the part of breeders of Polled cattle, followed by a corresponding improvement in the stock. They cannot but regard it as perhaps the most valuable breed of Scotland, combining, as it does, in a great measure, the constitution of the Highlander with the feeding properties of the Short-horn. At Perth, as on previous occasions, the Polled cattle formed the principal object of interest and admiration on the part of strangers from England and Ireland.

AYRSHIRE.

Judges.—William Forrest of Treesbank, Lanarkshire; Patrick Graham Barns of Limekilns, Lanarkshire; Arthur Mather, Nether Place, Renfrewshire.—*Attending Member*, His Grace the Duke of Athole.

Sweepstakes for Ayrshire Bulls—to A. W. Buttery, Monkland, Airdrie.

For the best Bull of any age—fifteen sovereigns, to A. W. Buttery, Monkland, Airdrie.

The silver medal—to Mr Calder, Miller's Neuk, Kirkintilloch, as the *breeder* of the best Bull.

For the best Bull, calved after 1st January 1850—eight sovereigns, to A. W. Buttery, Monkland, Airdrie.

For the best Cow of any age, in milk—eight sovereigns, to A. W. Buttery, Monkland, Airdrie.

For the second best—four sovereigns, to James Young, Handaxwood, Whitburn.

For the best Cow of any age, in calf—six sovereigns, to Alexander M'Lachlan, East Long-haugh, Bishopton, Renfrewshire.

For the second best—three sovereigns, to Robert Kirkwood, High Longmuir, Kilmaurs.

For the best Heifer, calved after 1st January 1850—six sovereigns, to John Paterson, Macorriston, Doune.

For the second best—three sovereigns, to William Muir, Haddington Mains, Biggar.

For the best Heifer, calved after 1st January 1851—four sovereigns, to John Hamilton, Burnbrae, Avondale.

From the character of the district more immediately connected with the Show, the exhibition of Ayrshires could not be expected to equal in numbers that at Glasgow in 1850. In point of quality, the bulls were generally superior in symmetry. The cows in calf were good, though somewhat deficient in weight; but those in milk were generally wanting in shape, condition, and weight. With reference to the question of weight, the Directors would reprint, as applicable to the late exhibition, the remarks called forth at Glasgow. "It is to be feared that the Ayrshire milking stock, of late years, has been bred to too light weights—a delicate appearance and a well-set udder being the points most aimed at. These points have been attained by the practice of starving the young heifers, with the supposed object of making them good milking cows; but a good milker, it is apprehended, will not be formed by any such negative means. An improvement, it is believed, would be effected in both points, were the heifers bred so as to attain heavier weights and greater substance; and on becoming cows, they would then not only prove greater milkers, but might easily be fed a hundredweight or two heavier. The paramount object to be held in view, in breeding Ayrshires, is obviously to obtain the largest quantity of good milk, with a tendency to fatten when put up to be fed; and neither of these ends will be attained by light weights and delicacy of appearance."

HIGHLAND.

Judges.—Lorne Campbell, Roseneath, Dumbartonshire; John Macfarlane, Faslane, Dumbartonshire; John S. Menzies of Chesthill, Perthshire.—*Attending Member*, Sir John Muir Mackenzie of Delvin, Bart., Perthshire.

For the best Bull of any age—fifteen sovereigns, to the Right Hon. Duncan M'Neill of Colonsay, Lord Justice General.

The silver medal—to Charles Stewart, late of Chesthill, as the *breeder* of the best Bull.

For the best Bull, calved after 1st January 1850—eight sovereigns, to John Macdonald, Inverlochlang, Lochearnhead.

For the best Cow of any age—eight sovereigns, to the Marquis of Breadalbane, Taymouth Castle.

For the second best—four sovereigns, to Neill Malcolm of Poltalloch, Lochgilphead.

For the best Heifer, calved after 1st January 1849—six sovereigns, to the Marquis of Breadalbane, Taymouth Castle.

For the second best—three sovereigns, to Robert Peter, Urlar, Aberfeldy.

For the best Heifer, calved after 1st January 1850—four sovereigns, to Donald M'Laren, Braeleny, Callander.

For the best pair of Oxen, calved after 1st January 1848—the medium gold medal, to Alexander Campbell of Monzie, Crieff.

EXTRA SECTIONS OF THE HIGHLAND BREED.

Open to tenants paying a rent not exceeding £100 *per annum.*

For the best Bull of any age. *No entry.*
For the best Bull, calved after 1st January 1850. *No entry.*
For the best Cow of any age. *No entry.*
For the best Heifer, calved after 1st January 1849. *No entry.*
For the best Heifer, calved after 1st January 1850. *No entry.*

Considering the proximity of the Show to some of the best breeding districts for Highland cattle, the exhibition in this class did not, in point of extent, realise what was anticipated. With regard to quality, the Judges had cause to repeat the statement which, it may be recollected, was contained in the notice of the Glasgow Show, that the aged bulls were inferior. On this occasion, with certain exceptions, their deficiency in size for breeding purposes was obvious. It is much to be regretted that recent Shows have not exhibited that progress in this interesting and valuable native breed which characterises stock of other descriptions. The younger bulls, cows, and heifers excelled the old bulls, and were equal to what have appeared on former occasions.

FIFESHIRE.

Judges.—J. B. Fernie of Kilmux, Fifeshire; Arthur Glennie, Fernieflat; Kincardineshire; John Graham, yr. of Shaw, Dumfriesshire; James Gulland, Newton of Wemyss, Fifeshire; George Milne, Haddo, Aberdeenshire. —*Attending Member*, Robert Stewart of Ardvorlich, Perthshire.

Sweepstakes for Fifeshire Bulls—to Robert Wilson, Firthfield, Anstruther.

For the best Bull of any age—ten sovereigns, to John Rintoul, Ovenston, Pittenweem.

The silver medal—to John Rintoul, as the *breeder* of the best Bull.

For the best Cow of any age—six sovereigns, to William Fullarton, Mains of Ardestie, Dundee.

For the best Heifer, calved after 1st January 1850—four sovereigns, to David Wallace, Balgrummo, Leven.

NOTE.—The Judges reported that only two animals were exhibited for the sweepstakes.

It is a question with many judges whether the Fifeshire breed exists in a pure state; if so, its numbers are insignificant, and its importance questionable. At no Show has the Society succeeded in bringing together above a few examples of the breed, and the Directors have it consequently in contemplation to discontinue offering premiums for it. The animals exhibited at Perth were not considered worthy of high commendation.

EXTRA CATTLE.

Judges.—James Gulland, Newton of Wemyss; John M'Laren, Millhill, Perthshire; John Smith, Kinblethmont, Forfarshire.—*Attending Member*, James B. Fernie of Kilmux.

The Judges commended the following animals :—

Short-horn Heifer belonging to William Stirling of Keir, Dunblane; Angus polled Cow and Calf belonging to Hugh Watson, Keillor, Coupar-Angus, highly commended; Six Highland Oxen belonging to the Earl of Glasgow; Two Highland Oxen belonging to the Marquis of Breadalbane; Four Highland Heifers belonging to the Marquis of Breadalbane; Highland Heifer belonging to the Hon. Lady Menzies of Menzies; Highland Heifer belonging to James Archibald Campbell of Inverawe; Two Cross Heifers belonging to William Dingwall, Ramornie, Fifeshire; Tuscany Cow belonging to Col. Ferguson of Raith, Kirkcaldy; Cross Heifer and Ox belonging to James L. Miller, Wauk Mill, Dunfermline; Two Cross Oxen belonging to George Brown, South Quarter, Kingsbarns, St Andrews.

In this class, the Cow and Calf of the polled breed, bred and exhibited by Mr Watson, Keillor, excited much interest. The cow is twenty-six years of age, and, having reared twenty-three calves, shows strikingly the sound constitution of the stock, which is now more than ever an important qualification. This cow, having long previously won the Society's highest premiums, was disqualified from competing, and had consequently to be exhibited as extra stock.

HORSES

FOR AGRICULTURAL PURPOSES.

Judges.—Archibald Butter of Faskally, Perthshire; Finlay Dun, V.S., Edinburgh; William Glen, Hawkhead Mains, Renfrewshire; James Steedman, Boghall, Mid-Lothian.—*Attending Member*, Sir P. Murray Thriepland of Fingask, Bart., Perthshire.

For the best Stallion—twenty-five sovereigns, to Samuel Clark, Manswrae, Kilbarchan.

For the second best—ten sovereigns, to John Smith, Grassmarket, Edinburgh.

For the best entire Colt, foaled after 1st January 1849—ten sovereigns, to Alexander Lawson, Old Mills, Elgin.

For the best entire Colt, foaled after 1st January 1850—eight sovereigns, to James Kay, Hillfarm, Gargunnoch, Stirlingshire.

For the best entire Colt, foaled after 1st January 1851—six sovereigns, to John and Peter Young, Niddry, Winchburgh, West Lothian.

For the best Mare—ten sovereigns, to A. W. Buttery, Monkland, Airdrie.

For the second best—five sovereigns, to Andrew Logan, Crossflit, Kilbarchan, Renfrewshire.

For the best Filly, foaled after 1st January 1849—eight sovereigns, to Robert Murdoch, Hallside, Cambuslang.

For the best Filly, foaled after 1st January 1850—six sovereigns, to Andrew Logan, Crossflit, Kilbarchan, Renfrewshire.

For the best Filly, foaled after 1st January 1851—four sovereigns, to Robert Jack, Balcarroch, Campsie, Stirlingshire.

EXTRA SECTIONS.—HIGHLAND PONIES.

Judges.—Archibald Butter of Faskally, Perthshire; John S. Menzies of Chesthill, Perthshire.—*Attending Member*, Archibald Campbell of Glendaruel, Argyllshire.

For the best Highland Pony Stallion, not over 14 nor under 12 hands—eight sovereigns, to Alexander Campbell of Monzie, Crieff.

For the best Highland Pony Mare, of the same height—five sovereigns, to Sir John Stuart Forbes of Pitsligo and Fettercairn, Bart.

EXTRA HORSES.

The Judges commended the following animals:—

Clydesdale Stallion belonging to Robert Arkley, Philipston, Queensferry; Carriage Stallion belonging to Robert Mackay, Dalkeith.

The appearance of the horses was highly creditable. The aged horses were, as usual, the most numerous, and there were amongst them many good specimens of powerful, active, and useful farm horses. The three-year-old colts were, as a class, somewhat inferior, except the first-prize horse, which was equal to anything of its age seen for some years. The two-year-olds were excellent, many of them promising to prove valuable stud horses. The yearlings were creditable, but not so good. The show of mares excelled that of horses; and, though surpassed at Glasgow in numbers, it was perhaps, in point of quality, one of the best ever brought together in Scotland. The mare which gained the first premium at Glasgow in 1850, and which was therefore, by the rules of the Society, disqualified for competition, was exhibited, and deservedly commended. The young mares were highly creditable, and though somewhat inferior to the aged ones, promise, when they reach maturity, to be superior breeding animals.

The Judges concurred in representing the great importance, too often overlooked, of carefully selecting and attending to colts and fillies from the earliest stage, and expressed a hope that the Society will continue to encourage this by giving, if possible, increased premiums for young animals.

SHEEP.

LEICESTERS.

Judges.—John Dudgeon, Spylaw, Roxburghshire; John Dudgeon, Almondhill, West Lothian; Thomas Scott, Beal, Northumberland.—*Attending Member*, Sir David Dundas of Dunira, Bart., Perthshire.

For the best Tup, not exceeding four years old—eight sovereigns, to John Davidson, Brandon Whitehouse, Northumberland.

For the second best—four sovereigns, to Thomas Dickinson, Maiden Hall, St Boswells.

For the best pair of Dinmont or Shearling Tups—eight sovereigns, to John Davidson, Brandon Whitehouse, Northumberland.

For the second best—four sovereigns, to James Douglas, Athelstaneford, Haddington.

For the best Pen of Five Ewes, not exceeding five years old—six sovereigns, to Adam Thomson, Rutherford, Kelso.

For the second best—three sovereigns, to William Tod, Elphinstone Tower, Tranent.

For the best Pen of Five Shearling Ewes or Gimmers—four sovereigns, to James Douglas, Athelstaneford, Haddington.

The Judges considered the quality of this stock to be of a superior description, more particularly in the sections of aged Tups and Gimmers, which possessed merit of a high order. In many instances, the excellence of the competing lots so nearly approximated, that considerable difficulty was experienced in awarding the Premiums.

CHEVIOTS.

Judges.—George Douglas, Plenderleith, Roxburghshire; Andrew Scott, Tarbat House, Ross-shire.—*Attending Member*, Alexander Macduff of Bonhard, Perthshire.

For the best Tup, not exceeding four years old—eight sovereigns, to James Brydon, Moodlaw, Langholm.

For the second best—four sovereigns, to Walter Carruthers, Kirkhill, Moffat.

For the best Pair of Dinmont or Shearling Tups—eight sovereigns, to Thomas Elliot, Hindhope, Jedburgh.

For the second best—four sovereigns, to Thomas Elliot, Hindhope.

For the best Pen of Five Ewes, not exceeding five years old—six sovereigns, to Thomas Elliot, Hindhope.

For the second best—three sovereigns, to James Brydon, Moodlaw, Langholm.

For the best Pen of Five Gimmers, lambed after 1st April 1851—four sovereigns, to Thomas Elliot, Hindhope, Jedburgh.

This stock the Judges reported as being generally of more than ordinary merit, many of the lots presenting examples of first-rate quality.

BLACKFACED.

Judges.—Alexander Denholm, Baitlaws, Lanarkshire; Kenneth Kennedy, Leanachan, Inverness-shire.—*Attending Member*, Alexander Campbell of Monzie, Perthshire.

For the best Tup, not exceeding four years old—eight sovereigns, to Robert Paterson of Birthwood, Biggar.

For the second best—four sovereigns, to Adam Blacklock, Minnygap, Moffat.

For the best Pair of Dinmont or Shearling Tups—eight sovereigns, to James Tweedie, Nether Abington, Lanarkshire.

For the second best—four sovereigns, to John and James Watson, Mitchellhill, Biggar.

For the best Pen of Five Ewes, not exceeding five years old—six sovereigns, to James Brydon, Kinnelhead, Moffat.

For the second best—three sovereigns, to Donald M'Laren, Braeleny, Callander.

For the best Pen of Five Gimmers, lambed after 1st April 1851—four sovereigns, to Patrick Small, Dirnanean, Kirkmichael, Perthshire.

The show of Blackfaced Sheep was considered, on the whole, to be very good, though it embraced some animals scarcely qualified to be presented on such an occasion. It is to be apprehended, not only that too little attention generally is paid to the improvement of Blackfaced Sheep, but that an indiscriminate system of crossing may ere long, in some districts, destroy its purity, if not

imperil its existence. It is earnestly hoped that every effort will be made to maintain the purity and develop the qualities of a breed so peculiarly suitable for many parts of this country.

SOUTHDOWNS.

Judges.—Andrew Bell, Hope House, Alnwick, Northumberland; George Willis, Keithock Mains, Coupar-Angus.—*Attending Member*, James Campbell of Craigie, Ayrshire.

For the best Tup, not exceeding four years old—eight sovereigns, to James Aitchison of Alderston, Haddington.

For the second best—four sovereigns, to Hugh Watson, Keillor, Coupar-Angus.

For the best Pair of Shearling Tups—eight sovereigns, to Hugh Watson, Keillor, Coupar-Angus.

For the second best—four sovereigns, to James Aitchison of Alderston, Haddington.

For the best Pen of Five Ewes, not exceeding five years old—six sovereigns, to Hugh Watson, Keillor, Coupar-Angus.

For the second best—three sovereigns, to William Tod, Elphinstone Tower, Tranent.

For the best Pen of Five Shearling Ewes or Gimmers—four sovereigns, to Hugh Watson, Keillor, Coupar-Angus.

The exhibition of Southdowns, though not equal, perhaps, to what may be seen in some parts of England, was the best the Society has yet had; and even in the opinion of the English Judges, many of the lots were examples of what "prime Downs" should be. At former Shows, this breed was, in some measure, ranked as a supernumerary class, and fewer premiums were given for it than for the others. At Perth, however, it was placed, in this respect, on a par with them, the Directors being anxious to direct attention to the extension of a race so remarkable for its docility, earliness, aptitude to fatten, and power of producing a superior carcase of mutton.

EXTRA SHEEP.

The Judges commended the following animals:—

Five Southdown Lambs, belonging to Robert Scot Skirving, Campton, Haddington.

Five Romney-Marsh Ewes, and Five Romney-Marsh Gimmers, belonging to David Park, Tynefield, Dunbar, commended as a breed likely to be useful in crossing with sheep for high pastures.

Five Romney-Marsh Wethers, belonging to John Brown Wright, Hedderwick Hill, Dunbar.

SWINE.

Judges.—Anthony Cruickshank, Aberdeen; James Gordon of Manar, Aberdeenshire; Claude Scott Steuart of Dalguise, Perthshire.—*Attending Member*, Alexander Duthie, Aberdeen.

For the best Boar, large breed—five sovereigns, to W. H. Brown of Ashley, Ratho, Mid-Lothian.

For the second best—three sovereigns, to John Gordon of Aikenhead, Glasgow.

For the best Boar, small breed—five sovereigns, to Jonathan Brown, The Height, Wigton, Cumberland.

For the second best—three sovereigns, to Robert Harrison Watson, Bolton Park, Wigton, Cumberland.

For the best Sow, large breed—four sovereigns, to George Hay Plummer, Melville, Dalkeith.

For the second best—two sovereigns. No award.

For the best Sow, small breed—four sovereigns, to John Arkley, Powmill, Brechin.

For the second best—two sovereigns, to A. W. Buttery, Monkland, Airdrie.

For the best Pen of Three Pigs, not exceeding eight months old—four sovereigns, to Jonathan Brown, The Height, Wigton, Cumberland.

For the second best—two sovereigns, to the Earl of Mansfield, Scone Palace.

There were some excellent specimens of the small breed, but the show of the large was deficient. This may partly be accounted for by exhibitors improperly entering animals belonging to it for competition with the small class. When this was observed, the lots were of course passed by the Judges; and it is believed that in some instances parties, by unfairly attempting to compete out of their proper class, lost the premiums which might probably have been awarded to them in it. The Judges noticed with commendation that there was less of that extra feeding and excessive fatness which has of late so much prevailed, and which the Society so strongly condemns in all breeding animals.

POULTRY.

Judges.—James Gordon of Manar, Aberdeenshire; Claude Scott Steuart of Dalguise, Perthshire—*Attending Member*, Patrick Keir, yr. of Kinmonth, Perthshire.

For the best pair of Turkeys, Norfolk or Black breed—one sovereign, to James Wilson, Woodburn, Dalkeith.

For the best pair of Turkeys of any other breed—one sovereign, to the Marquis of Breadalbane, Taymouth.

For the best pair of Capon Turkeys. *No entry.*

For the best pair of Fowls, mottled or speckled, Dorking breed—one sovereign, to Robert E. C. Benton, Glasgow.

For the best pair of Fowls, Polish breed. *No award.*

For the best pair of Fowls, Spanish breed—one sovereign, to R. E. C. Benton, Glasgow.

For the best pair of Fowls, gold or silver spangled, Hamburgh breed—one sovereign, to R. E. C. Benton, Glasgow.

For the best pair of Fowls, grey speckled or old Scotch breed. *No award.*

For the best pair of Fowls, Malay breed—one sovereign, to R. E. C. Benton, Glasgow.

For the best pair of Fowls, Cochin-China breed—one sovereign, to R. E. C. Benton, Glasgow.

For the best pair of Fowls of any other breed—one sovereign. *No award.*

For the best pair of Capons. *No entry.*

For the best pair of Poulards. *No award.*

For the best pair of Ducks, Aylesbury breed—one sovereign, to the Marquis of Breadalbane, Taymouth.

For the best pair of Ducks of any other breed—one sovereign, to Sir Thomas Moncreiffe of Moncreiffe, Bart., Perth.

For the best pair of Geese—one sovereign, to William Muir, Hardington Mains, Biggar.

The exhibition was more than usually large, but in point of quality the Judges have not reported favourably. There was a want of superior birds generally, and the deficiency was particularly noticeable in the section of Dorkings.

DAIRY PRODUCE.

Judges.—Robert Greig, merchant, Perth; Charles Matthew, merchant, Perth; Francis Richardson, Edinburgh; Lawrence Rintoul, merchant, Perth.

For the best sample (not less than 14 lb.) of Butter, cured in 1852—three sovereigns, to Adam Roy, Broadlees, Dunblane.
For the second best—two sovereigns, to James Gibson, Pitlochrie, Perthshire.
For the best sample (not less than 14 lb.) of Powdered Butter—three sovereigns, to James Patrick M'Inroy of Lude, Blair-Athole.
For the second best—two sovereigns, to Mrs William Sutherland, Dalmore, Alness.
For the best sample of Fresh Butter, three rolls, of ½ lb. weight each—three sovereigns, to Lady Louisa Moncreiffe of Moncreiffe, Perth.
For the second best—two sovereigns, to Sir John Stuart Forbes of Pitsligo and Fettercairn, Bart.
For the best couple of Cheeses made from Sweet Milk in 1852—three sovereigns, to James Allan, Westmains, Stonehouse, Lanarkshire.
For the second best—two sovereigns, to John Dunlop, Whiteshaw Gate, Strathaven, Lanarkshire.
For the best couple of Cheeses made from Skimmed Milk in 1852—three sovereigns, to Mrs Buchanan, Gilkhorn, Arbroath.
For the second best—two sovereigns, to Thomas Muir, Bowhouse, Lanark.
For the best imitation of any known description of English Cheese—three sovereigns, to M. S. M'Inroy, Lude, Blair-Athole. (*Stilton.*)
For the second best—two sovereigns, to James Allan, Westmains, Stonehouse, Lanarkshire. (*Stilton.*)

The exhibition in this department was, in point of extent, inferior to what has been witnessed in other districts where the dairy forms a more important element in the economy of the farm. In quality, however, it was reported by the Judges as equal to anything they had previously seen, and as highly creditable to the exhibitors. The fresh butter met with special commendation, as well as the samples of imitation English cheese, the Stilton being pronounced equal to any that the county of Leicester produces.

IMPLEMENTS.

Judges.—John Finnie, Swanston, Mid-Lothian; John Gibson, Woolmet, Mid-Lothian; James Horne, C.E., Edinburgh; Alexander Macfarlane, Foundry, Perth; Lawrence Oliphant of Condie, Perthshire; Joseph Scholes, Railway Station, Perth; James Slight, Edinburgh; James Steedman, Boghall, Mid-Lothian; Henry Stephens, Edinburgh; Robert Steuart of Carfin, Lanarkshire; James Stirling, C.E., Edinburgh; William Watson, Errol, Perthshire.

SECTION 1.—For the best Two-Horse Plough for general purposes—two sovereigns, to George Ponton, Grougfoot, Linlithgow.

The Judges reported a marked improvement in this implement, and stated that the general collection was most creditable to the exhibitors. Seven ploughs were selected by the Judges for trial, the result of which was most satisfactory, and confirmed the opinion previously formed of their different merits. The plough to which the first premium was awarded not only did its work better, but, upon applying the dynamometer, was found to require less power of draught than any of the others selected for trial.

2. For the best Trench or Deep-Furrow Plough. *No award.*

3. For the best Subsoil Plough for two horses. *No award.*

4. For the best Subsoil Plough for moor and stony land, for three or four horses. *No entry.*

5. For the best Double Mould-Board Plough for forming Drills—two sovereigns, to James Barclay, Castleton, Fowlis, Crieff.

The entries in this section exhibited a decided improvement, and justified the Judges in reporting in the same terms as under Section 1.

6. For the best Ribbing or Drill-Paring Plough. *No award.*

7. For the best Two-horse Grubber or Cultivator, working on the flat—two sovereigns, to Robert Law, Shettleston, Glasgow.

The Judges reported an increase in the numbers, and a marked improvement in the simplicity of the construction of this class of implements.

8. For the best Drill Grubber for Green Crops. *No award.*

9. For the best Norwegian Harrow—three sovereigns, to James Kirkwood, Tranent.

The Judges reported most favourably of the implement which gained the first premium in this section. In the trial, it fully maintained the superiority it had formerly shown, and proved itself, upon being tested by the dynamometer, to be of easier draught than had hitherto been supposed.

10. For the best Consolidating Land-Roller. *No award.*

11. For the best Land-Presser for preparing Seed-Bed for Grain—three sovereigns, to David Galloway, Cumno, Alyth.

The Sowing Machine attached to this implement was considered to be a decided improvement.

12. For the best Pulverising Land-Roller—three sovereigns, to Gibson and Richardson, Newcastle-on-Tyne.

The principle upon which this implement is constructed is new to the exhibitions of the Society, and was highly approved of by the Judges upon trial.

13. For the best Harrows—two sovereigns, to William Crosskill, Beverley.

The Bedford Patent Harrow, upon trial, again proved itself superior to all the others that were entered in competition.

14. For the best Common Swing-trees or Draught-bars. *No award.*

There being nothing new in the construction of the articles exhibited, no premium was awarded, but they were commended for their superior workmanship.

15. For the best Equalising Swing-trees or Draught-bars—one sovereign, to James Kirkwood, Tranent.

Though there was nothing new, a premium was awarded by the Judges in consequence of the attention bestowed on the equalisation of the draught, when more than two horses are required, and from the high finish of the implement.

16. For the best Broadcast Sowing-Machine for Grain and Grass Seeds—three sovereigns, to John Lennie, Lauder Barns, Lauder.

The machine to which the Judges awarded the premium is constructed upon an improved principle. It will work better on hilly ground, and is better adapted for removal from one field to another, than those hitherto exhibited.

17. For the best Drill Sowing-Machine for Grain—three sovereigns, to Thomas Sherriff, West Barns, Dunbar.

The Judges reported a general improvement in this class of implements.

18. For the best Horse-Hoe for Drilled Grain Crops—four sovereigns, to Thomas Sherriff, West Barns, Dunbar.

A general improvement in this class was also reported.

19. For the best Sowing-Machine for Turnips. *No award.*

20. For the best Sowing-Machine, for Beans, sowing three rows. *No award.*

21. For the best Dry Manure Distributing Machine—two sovereigns. *No entry.*

22. For the best Liquid Manure Distributing Machine—three sovereigns, to William Herkless, Glasgow.

The Judges deemed this construction of pump as useful in dispersing liquid manure over the ground, and it might also be employed as a water-engine in case of fire at a farmstead.

23. For the best Liquid Manure Pump—one sovereign, to A. and W. Smith and Co., Paisley.

Although this was the only pump entered in competition in this section, the Judges deemed it worthy of the premium, on account of its being made of copper, taking up little room, being easily arranged and removed, pumping liquids effectively, and being moderate in price. Such an implement would be useful in

all sorts of farms, for pumping liquids of any kind at any required place.

24. For the best Straw-Cutter for hand-labour—two sovereigns, to Richmond and Chandler, Manchester.

25. For the best Straw-Cutter for power—three sovereigns, to Richmond and Chandler, Manchester.

Both these machines are of the same construction, the latter being only a little larger than the former. The Judges remarked that they all exhibited the usual high finish and correctness of construction which the machines exhibited by Richmond and Chandler at former Shows of the Society possessed. They also observed that the gearing now employed is much more simple, and fewer, than those attached to similar machines exhibited by that firm, and in consequence they are more generally useful, and their price more moderate.

26. For the best Turnip-Cutter for sheep—two sovereigns, to James Kirkwood, Tranent.

There was considerable competition in this section. The Judges preferred the one made by James Kirkwood, because it is wholly composed of iron, not likely to go out of order, and is so constructed that it can either be wrought by hand or attached to a cart; and it has the further advantage, while travelling over grass land, of cutting the turnips for stock. That of Carson's construction, exhibited by Lord Kinnaird, was commended, on account of its cutting a large quantity of turnips in a given time; but it cut them too small for cattle; and yet, were the turnips mixed with chaff, it seems well adapted for even that species of stock. Smith & Co. of Paisley exhibited a turnip-cutter by hand-power, whose action is horizontal; and it can slice turnips for cattle at one end, and for sheep at the other, at the same time.

27. For the best Turnip-Cutter for Cattle—one sovereign, to C. D. Young and Co., Edinburgh.

28. For the best Turnip-Cutter for Sheep, adapted for attachment to a Cart—three sovereigns, to John Hutchison, Craigend, Perth.

Only one competitor appeared in this section; and although the workmanship was slovenly, and the whole machine would admit of much improvement, the Judges considered the principle of its construction good.

29. For the best Linseed-Bruiser for hand-labour—two sovereigns, to Richmond and Chandler, Manchester.

30. For the best Grain-Bruiser for hand-labour—two sovereigns, to A. and W. Smith and Co., Paisley.

31. For the best Grain and Linseed Bruiser for power—three sovereigns, to Richmond and Chandler, Manchester.

32. For the best Bean-Bruiser for hand-labour. *No entry.*

The bruisers by Richmond and Chandler were highly finished

and efficient, bruising either grain or linseed, the feed of the grain being regulated by a screw. The grain-bruiser of Smith & Co. would bruise the largest quantity of grain in a given time, the feed being regulated by the common clack, but the Judges conceived that the rollers would be materially injured were nails or stones by any accident to get amongst the grain.

33. For the best Root-Washer. *No award.*

34. For the best Steaming Apparatus for preparing food—three sovereigns, equally between Richmond and Chandler, Manchester, and A. and W. Smith & Co., Paisley.

Both these steaming apparatuses were deemed by the Judges useful for both large and small farms, and either may be made double or single as desired.

35. For the best set of Troughs for Feeding-Byres. *No award.*

The Judges awarded no premium in this section, deeming clay to be an unsuitable material for pigs' troughs in a farmyard, and considering the iron pig-trough exhibited inconvenient and clumsy.

36. For the best One-horse Farm-Cart—three sovereigns, to Alexander Scrimgeour, Methven, Perth.

Alexander Scrimgeour's cart is strong and substantial, well adapted for farm purposes, durable, and moderate in price, (£9.) That by Alexander Young the Judges strongly commended as being well put together, but it is high in price, (£13,) its excellence consisting in binding the fore and back cross-bars to the shafts with a bar of iron, instead of bolts. Mr Law's carts exhibited good workmanship and materials.

37. For the best Light Spring-Cart, for farm or other purposes—two sovereigns, to William Crosskill, Beverley.

The Judges deemed this a useful cart; and it is well constructed, like all the workmanship which Crosskill invariably exhibits.

38. For the best Harvest Cart. *No award.*

39. For the best Stone or Iron Stack Pillars, with Framework—two sovereigns, to Young, Peddie, and Co., Edinburgh.

The Judges preferred the stack pillars made by Young, Peddie, & Co., taking the construction, material, and cost into account. Those made by Charles D. Young & Co. they commended as being well constructed.

40. For the best Hay Tedding Machine—two sovereigns, to Richard Hodgson of Carham, Coldstream.

41. For the best Horse Stubble or Hay Rake—one sovereign, to Lawrence Oliphant of Condie, Perth.

This hay-tedding machine is of English origin, and it has not yet been adopted by Scottish farmers, from some preconceived notion that it is not suited for the making of artificial grasses into

hay. However this may be, the Judges believe that a more efficient machine for effectually tedding hay can scarcely be constructed. The agricultural public is much indebted to Mr Hodgson for showing them the really useful purposes of this machine. The improvement on the hay-rake by Mr Oliphant consists in strengthening the axle, by extending its bearings. The workmanship of James Kirkwood's hay-rake was commended by the Judges. All the machines of this section were remarkably well constructed and manufactured.

42. For the best Improvement on any part of the Thrashing Machine—five sovereigns, to Peter M'Lellan, Bridge of Earn, Perth.

Three improvements have been effected in parts of the ordinary Scotch thrashing-machine by Peter M'Lellan. One consists in simplifying the shaker, by removing a number of the teeth, and introducing a brush, to sweep the loose grain into the hopper of the fanners. Another improvement is the introduction of the diamond beaters upon the drum, by which the grain is more easily and effectually separated from the straw than by the common beaters; but the chief improvement is effected in the elevators, by which the roughs are taken from the under to the upper barn in an effectual manner, by a simple means, economising the power. The Judges conceive that the small thrashing-machine exhibited by Macartney and Drummond in this section is of very superior workmanship; and they regret that the placing it in this section—which they consider a wrong one for it—deprived them of the power of awarding a premium to it.

43. For the best Thrashing-Machine, not exceeding two-horse power—six sovereigns, to Robert Steuart of Carfin, Lanarkshire.

The portable English thrashing-machine, introduced into this country by Mr Steuart of Carfin, was made by Edward Pellew of Plenty, Berkshire, is a neat, compact, well-constructed machine, and can be easily moved from place to place. If it had a ratchet gearing, to counteract any inordinate force of the working power, and a stronger spur-wheel, the Judges conceived that this would be a very perfect portable machine. Mr Crosskill's portable machine, which was commended by the Judges for its workmanship, is quite suitable for small farms. It may be well here to refer the reader to the comparative merits of portable machines, which are discussed in a paper of this number of the Transactions, at p. 382.

44. For the best Thrashing-Machine, with English high-speed open Drum, combined with Shakers, Fanners, &c., on the Scotch principle. *No entry.*

45. For the best Barley Hummeler, for attachment to a Thrashing-Machine. *No entry.*

46. For the best Dressing Fanners for Grain—three sovereigns, to Robert Reid, Leysmill, Forfarshire.

The Judges considered the fanners were of superior description.

That exhibited by Robert Reid was well constructed, and the riddling and dressing part superiorly adapted to produce a sample of clean grain. The driving wheels being judiciously placed out of the way is a distinguishing feature of this machine. Smith & Co.'s dressing fanners displayed good workmanship, and were commended.

47. For the best Weighing Machine for the Barn, indicating measure and weight of grain at one operation. *No entry.*

48. For the best Weighing Machine, indicating from 1 lb. to 2 tons—three sovereigns, to A. and W. Smith and Co., Paisley.

The characteristic distinction of Smith & Co.'s weighing-machine is the enclosing of the machinery within a cast-iron box, which may be placed anywhere in the ground, without the aid of masonry.

49. For the best Churn worked by hand—two sovereigns, to Peter M'Lellan, Bridge of Earn, Perth.

50. For the best Churn worked by power—two sovereigns, to Charles D. Young & Co., Edinburgh.

The competition in churns was extensive; but the Judges could not fail to observe that a tendency is manifested by the manufacturers to introduce a complication of machinery in connection with the moving power—a tendency which they consider ought not to be encouraged by the Society. The premium churn, of the box description, was of the simplest construction; and although of itself consisting of zinc, which is objectionable, the form could as well be made in wood. The commended churn of Philip Hunter of Edinburgh was of the old upright form, but furnished with a double plunger, set in motion by means of simple cranks. The churn worked by power was of rather objectionable form, inasmuch as the ropes which govern it are apt to slip off in the operation. But as the implement was well manufactured by Charles D. Young & Co., the Judges awarded the premium.

51. For the best Cheese Press—one sovereign, to Macartney and Drummond, Cumnock, Ayrshire.

There was considerable competition in this section, and the Judges preferred the one by Macartney and Drummond, because of its simple form and inexpensive cost. That exhibited by Richmond and Chandler is of very compact form, and exhibiting beautiful workmanship was commended.

52. For the best Curd-Cutter for Dairy purposes. *No award.*

53. For the best general Set of the Smaller Utensils of the Dairy. *No entry.*

54. For the best Field-Gate, constructed entirely of Iron—one sovereign, to Thomas Gorrie, Perth.

The iron field-gate of Thomas Gorrie was remarkably neat, and strongly constructed, with diagonal bars, and moderate in expense,

and seems well adapted, in the opinion of the Judges, for field purposes. The tension bar-gate of Charles D. Young and Co. was commended as a well-constructed article. There was considerable competition in this section.

55. For the best Field-Gate, not constructed entirely of Iron. *No entry.*
56. For the best set of Travis Divisions, Rack and Manger, for Farm Stables—two sovereigns, to Charles D. Young and Co., Edinburgh.

The Judges considered that such iron heel-posts, iron skeleton frames for the travis-boards, together with the iron rack and manger, would be well adapted for farm stables.

57. For the best set of Farm Harness—premium equally between James Dunlop, Haddington; Hunter and Allan, Kelso; and Alexander Russell, Pitmachie, Aberdeenshire.

The Judges could not but consider the advances made at this Show, in the improvement of farm harness, as very remarkable, no less than three different modes of adjusting the shape of the cart saddle to the back of the horse being presented in competition; and the advantages presented by each were so obvious, that it was impossible for the Judges to draw a distinction between them. So they recommended to the Directors to give a premium to each of the three competitors. Both the material and workmanship of the harness, which was nevertheless very simple in construction and inexpensive in cost, were objects of admiration.

58. For the best Machine for making Drain Tiles and Pipes from Clay. *No entry.*
59. For the best Machine for separating extraneous matter from Clay, and preparing it for the Manufacture of Tiles and Pipes. *No entry.*
60. For the best Machine for Milling, Screening, and Moulding Clay into Tiles and Pipes, by a continuous operation. *No entry.*
61. For the best set of Tiles and Pipes for Field Drainage—one sovereign, equally between James M'Alpine, Stirling, and Alexander Meldrum, Seafield Tile-works, St Andrews.

All the draining materials of this section were excellent in the opinion of the Judges. They could not determine the superiority between the articles produced by James M'Alpine and Alexander Meldrum, so the premium was divided between them; and those of the others were very little inferior to the prize articles.

62. For the best set of Glazed Socketed Pipes for Sewerage—one sovereign, to the Aberdeen Brick and Tile Company, Aberdeen.

This was also a well-contested section, and the Judges only after much difficulty awarded the premium to the Aberdeen Brick and Tile Company, because their prices were the lowest, and the sockets and bends exhibited by them were particularly good, and reasonable in price.

63. For the best set of Tools for Cutting Field Drains—one sovereign, to William Cadell, Sons, & Co., Cramond.

64. For the best set of Tools for Cutting Open Drains in Hill Pastures—one sovereign, to William Cadell, Sons, & Co., Cramond.

The quality of the tools made by William Cadell, Sons, & Co. is well known and generally appreciated, so the Judges had no hesitation in awarding the premiums to them, although they were the only competitors in the section.

65. For the best general set of Hand Implements for the Farm. *No entry.*

66. For the best Apparatus for preparing Flax—ten sovereigns, to A. & W. Smith & Co., Paisley.

Smith & Co. exhibited a complete set of apparatus for preparing flax for the manufacturers, which manifested much ingenuity in construction, neatness of workmanship, and apparent durability in the materials. Although no other competitor appeared, the Judges awarded the premium with much satisfaction to this most effective series of machinery. The preparation of flax by means of improved machinery, and by a different party from the grower, is now eliciting much solicitude, as well in farmers as in manufacturers, especially in Ireland.

67. For the best Reaping Machine—twenty sovereigns, to George Bell, Inchmichael, Errol.

The account of the trial will be found below.

EXTRA IMPLEMENTS AND MACHINES, AND GENERAL COLLECTIONS.

The report by the Judges of this department, after a careful examination of all the articles submitted to their consideration, was of a very favourable character. In many instances the style of construction, the mode of finish, and the mechanical skill displayed, reflected great credit on the manufacturers. Besides this general expression of opinion, the Judges reported the following list of articles which were thought more especially deserving of commendation:—

An eccentric grinding mill, by William Crosskill, Beverley. This article deserves notice for its superior workmanship and its portability. Machine-made cart-wheels, by the same, were of excellent quality and moderate in price. Kirkwood's grubber, by James Kirkwood, Tranent, possessing the usual excellence in form and workmanship of the maker. Sheep fodder rack, by the same.

Double mould-board or drill plough, by Thomas Reid, Monkton Miln. The plough is combined with an apparatus that sows turnip in one drill, while the plough is setting up the one adjoining. It was tried on the field, and found to work satisfactorily.

Grass-mowing machine for horse-power, by Alexander Shanks & Son, Arbroath, for mowing and rolling lawns. This implement

is after the model of Budding's famed mowing machine, and is constructed in Messrs Shank's usual handsome style.

Portable steam-engine, six-horse power, exhibited by A. and W. Smith and Co., Paisley. It was manufactured by Clayton and Shuttleworth, Lincoln. In the opinion of the Judges, its power is over-estimated, but the workmanship was in every respect admirable, and Messrs Smith are entitled to credit for their public spirit in bringing it down from England.

Stack ventilator, by Francis Somner, Kelso. This is a square tube of deal, rising up through the centre of the stack, and crowned with a ventilating hood above the apex. The tube is all over perforated to admit air, and at bottom furnished with four radial hollow arms, through which the current of air is first received. The principle seems sound, though the tubes appear small for their duty.

Draining pavement bricks, by John Quarton, Cuttlehill, Inverkeithing—patentee, William Forbes, Ellon—for the floors of byres and feeding-houses, combining the advantage of the sparred floor with that of solid pavement.

Sheep-dipping apparatus, by Thomas Bigg, London, well known for its economy and efficiency.

Machine for making staples for wire-fencing, by Thomas Dover, Pitlochrie, a new and useful invention.

Improved bee-hives, by Robert Halket, Perth.

Dog-cart, with balancing apparatus, by George Thomson, Stirling.

A complete assortment of the implements and machines used on a farm, exhibited in their actual working condition, by the Right Hon. Lord Kinnaird. This was the most interesting and useful group in the implemental department. The greater part of the articles were by makers of eminence, while a few had been constructed or improved under his Lordship's own direction, assisted by his intelligent manager, Mr M'Laren. Of these last there may be noticed an improved grass-seed sowing machine, possessing every qualification for performing that process in the best manner; also a Carson's turnip-cutter for sheep, fitted up in superior style, and an interesting combination of a gigantic straw-cutter, fitted for occasional attachment to the thrashing machine, when the entire discharge is cut down for litter, in lengths from 4 to 6 inches.

A general collection of implements, by James Slight, Edinburgh, presenting considerable variety, amongst which the following are more specially noticeable: The Tweeddale subsoil and trench ploughs, a Howard's wheel plough, light subsoil trench-plough, diamond and rhomboidal improved harrows, oilcake breaker, and dynamometer. Mr Slight was found entitled to high commendation for his collection; and it should be noticed that on this, as on former occasions, he might have been ranked

among the successful exhibitors in the premium sections, were it not that, owing to his official connection with the Society, he declines to compete for its premiums, though always ready to add to the usefulness and attractiveness of its Shows.

Collection of articles in fire and common clay, by the Grangemouth Coal Company, embracing fountains, vases, pedestals, &c., and displaying great artistic taste.

Collection of articles in fire-clay, from the works of John Wauchope, Esq. of Edmonstone, consisting of vases, pedestals, chimney-tops, &c., of very elegant designs. Particular attention was drawn to a fire-clay oven for kitchens, handsomely mounted with metal door, &c.

Collection of wire-netting, and articles of like manufacture, by Thomas Gorrie, Perth. The wire netting was remarked for its substantial quality and moderate price.

Collection of iron hurdles, garden-chairs, and other articles in wrought-iron, &c., by Charles D. Young & Co., Edinburgh. The leading article—the hurdles—in this collection, were of the usual substantial construction and good workmanship of this well-known house.

A large collection of gates, hurdles, wire netting, and other wire works, by Young, Peddie, & Co., Edinburgh, exhibited tasteful and substantial examples of the manufacture of this establishment. A wrought-iron carriage gate, with side wickets, was particularly noticed.

REPORT OF THE TRIAL OF REAPING MACHINES.

Out of five Reaping Machines exhibited, four were on the principle of Hussey's, and one on that of the Rev. Patrick Bell. Of these, only two were entered for trial. The Hussey machine was from the well-known house of Crosskill of Beverley, the other was the early constructed Scotch machine, invented in 1828 by Patrick Bell, with certain improvements lately introduced by his brother, George Bell, of Inchmichael farm, Perthshire.

As has already been stated, arrangements were made by the Secretary to conduct the trial on the farm of Muirton, and three fields—oats, barley, and wheat—were placed by Mr Morton, the tenant, at the disposal of the Society for the experiment.

The following Judges were appointed to superintend the trial:—Lawrence Oliphant of Condie; Henry Stephens, author of *The Book of the Farm;* James Stirling, Civil Engineer, Edinburgh; John Finnie, Farmer, Swanston; John Dickson, Farmer, Saughton Mains; John Gibson, Farmer, Woolmet; James Steedman, Farmer, Boghall; William Watson, Millwright, Errol; John Young, Engineer, Newton-upon-Ayr.

The practical farmers to whom the duty was intrusted were purposely selected from districts unconnected with the Perth Show, so as to be free from any bias which possibly might have been

ascribed to those in whose neighbourhood Bell's machine has long been in operation. His Grace the Duke of Athole, with his characteristic energy and activity, superintended the whole arrangements; and Hugh Watson, Keillor, attended the trial as arbiter between the Society and the Tenant, in the event of any question arising as to damage sustained by the crops. Owing, however, to the orderly conduct of the vast crowd of spectators, Mr Watson's services were not required.

A space was first cut by the sickle along the ends of the fields, so as to enable the machines to commence. Hussey's, from being *drawn* by the horses, requires a further clearance along the sides sufficiently broad to allow the horses to walk. Bell's, on the other hand, being *propelled* by the horses, and having the power of delivering the grain to the right or left, opens a passage for itself at any point, whether at the side or in the centre of a field; hence in each trial it took precedence in starting. Each machine was worked by two horses.

The first essay was in a field of oats. The crop was standing and nearly ripe, consequently in a favourable condition for machine-cutting, although it stood rather thin on the ground. Bell's machine at first created an impression, from the slow movement of its shears, (making only about 110 strokes per minute,) that it might pass over and crush the grain. A second or two, however, sufficed to dispel this; and as the implement progressed, it left a stubble about four inches high, cut with the most perfect regularity, and so clean that scarcely a straw or a grain was observable on it. A stoppage occurred to allow some adjustment to the height of stubble, and, during the five or six turns made by the machine, two or three stoppages took place in crossing deep furrows and unequal ground; but, on the whole, the work was well and continuously performed. The cutting was perfect throughout, and the corn laid with great regularity in an unbroken swathe, the straw lying at an angle of 30° with the line of progress. The breadth of the cut, when shut on both sides, is 6 feet, but cutting with an open side, the breadth seems not to exceed 5½ feet. In the present case the average of four turns was only 5 feet.

Hussey's machine next came into operation on the oats. The rapid vibration of its cutters, which gave about 570 strokes per minute, produced a feeling of confidence at the start that it would leave nothing uncut; and the first turn, though not performed without stoppage, was satisfactory with respect to cutting. The grain, however, was not so well laid as by Bell's, and the stubble was higher and not so clean. The succeeding cuts were less satisfactory, frequent stoppages occurred, and when there was any under-growth of grass, the machine was greatly baffled. While the operation of cutting was fairly performed, it was evident that the radical defect of the machine lay in the want of sufficient and regular means for removing the grain when cut. This division

of the process depended exclusively on the rakeman, and when he missed the proper moment for removal, the cutters were immediately choked. In point of economy, a most important defect was observable—the breadth cut by Hussey's did not, on an average, exceed 3¼ feet.

The barley crop was much heavier than the oats, and partially laid, thus presenting greater difficulties to the machines. The superiority of Bell's was here decided in every respect, while the more frequent stoppages of Hussey's, from choking, seemed to be caused partly by the greater weight of the crop, but mainly by the inability of the rakeman to perform his duties under the combined difficulty of a partially matted and a heavy crop.

In the wheat field the crop was of great weight and strength, estimated at a produce of six quarters the imperial acre; and here the decided superiority of uniformly continued mechanical action over intermitting muscular force was strikingly illustrated. Bell's machine, at the outset, cutting a breadth of 5½ feet along the edge of a ditch, had a stoppage from inequality of surface, after which it proceeded almost without intermission, cutting its regular breadth, and laying the wheat with great regularity, three or four straws only being seen out of the proper angle on the top of the swathe. Under this ordeal, Hussey's had still some merit. It cut a fair stubble, though higher than desirable. It began with its usual breadth, but even that (small compared with Bell's) was beyond the powers of the rakeman to remove; the machine consequently became choked at intervals of a few yards, and it ultimately appeared necessary to reduce the breadth of cut to about two feet. In the wheat, therefore, the comparative failure of this machine was, under any economical view, obvious and decided. The action of the fan in Bell's machine, in gathering and depositing the crop upon the web, induced an apprehension that the grain might to some extent be beaten out. This the Judges carefully investigated, and found to be groundless.

Taking into consideration all the circumstances of these trials, the Judges unanimously felt warranted in awarding the premium to Mr Bell, for the following reasons:—

1st, For the decided superiority of his machine in economising time and expense, owing to the greater breadth cut by it with the same horse-power—the difference being as 10 to 6½.

2d, For the character and quality of the work performed by it, as being cleaner cut, producing less waste or shake, and laying the swathe with a regularity better suited for binding in sheaves than when laid off in unequal bundles.

3d, For being less liable to choke, and to the consequent stoppages.

4th, For being mechanically adapted to deposit the grain in rows, performing the operation in a superior manner, and saving, in the opinion of the Judges, the labour of two men, as compared with Hussey's.

5th, For the advantages arising from its having the means of laying off the grain to the right side or the left, this feature, combined with that of being propelled instead of being drawn, enabling it to enter on either side, or into the centre of a field, without any previous clearing, and to continue the cutting without interruption while the cut portion of the crop was lying on the ground.

6th, For greater efficiency when operating on a crop partially lodged.

JN. HALL MAXWELL, *Secretary*.

SUMMARY OF THE DISCUSSIONS AT THE MONTHLY MEETINGS OF THE SOCIETY IN 1851-2.*

By THOMAS ANDERSON, M.D., Chemist to the Society.

I HAVE selected for the subject of the following address a summary of the discussions at the monthly meetings of the Highland and Agricultural Society during the past winter, and I have done so for several reasons. It has appeared to me that these meetings have now become an essential, and, as I think, a very important part of the business of the Society, and that there could not be a more favourable opportunity of referring to them than that afforded by the General Show, when a larger number of the members is gathered together than at any other time; and that these meetings may in this way be brought under the notice of many persons, who might not otherwise pay to them that attention which the importance of the subjects discussed, and the valuable observations of the different speakers deserve. I have been influenced also by the belief that the system of holding such meetings admits of much extension, and that what has been done by the Society as a great national institution might be carried out by local clubs with great advantage, not only to their members, but to agriculture at large. To a certain extent this has already been done, for several local clubs hold meetings for discussion; and I can speak from personal experience of the admirable manner in which the business of such of them as I have had an opportunity of visiting is conducted, and the benefit they have conferred on their district. A local club which holds discussions I have always observed to be the centre of an increased amount of skill and energy; in its district the agriculture is always more advanced, and there is a readiness to adopt what is new, tempered with a sound discretion, which prevents the rash and indiscriminate trial of all novelties, but confines it to such improvements as a sound knowledge of the capabilities of the district render probably successful.

The interchange of opinions between man and man is fraught with advantage in every branch of knowledge; but it is peculiarly

* Dr Anderson delivered this address on the occasion of the General Show at Perth in August last.—ED.

so in agriculture, for an individual who is isolated from his neighbours is apt to fall into a routine, which he has found to insure a certain amount of success, and becomes indisposed to adopt what might probably be improvements. Many a man, too, has not the opportunity of learning from books the progress of agriculture, or, if he has, he is often unwilling to alter his practice, either from a doubt, which is very commonly, and to some extent correctly entertained, regarding the efficiency of mere book learning in his art, or from that *vis inertiæ* of which every man has more or less in his composition. But make him a member of a club, in which he hears the very same matters discussed by word of mouth, and the pros and cons distinctly pointed out by men whom he knows to be successful farmers, and he is stimulated to inquire how far they may be applicable to his own case, and to try them either in their integrity, or with such modifications as may appear necessary to suit them to the requirements of his own farm. But there is another advantage which such meetings afford, and which is prominently brought out by the discussions which I am about to bring under your notice: they have a tendency to improve not merely the practice of the art, but to direct the attention of practical men to the principles on which that practice depends; and it is impossible to look carefully into any of them, without observing a constant reference to scientific principles, and a concordance between the inferences of science and the results of practice, which most convincingly indicate that we are slowly though surely establishing a correct basis for agriculture, elevating it from the rank of an art to that of a science, and raising it to that position which it deserves to hold, not merely from its material importance, but from its real interest as a branch of knowledge.

The discussions of the past season have been four in number:—

1st, The best modes of feeding and housing fattening cattle, and the breeds most suitable for different districts.

2d, Turnip culture.

3d, On the value, in point of economy, immediate effect, and durability, of guano and other special manures, compared with farm-yard manure, the produce of turnips alone, as well as conjoined with cake, grain, or other extra feeding.

4th, On the cultivation of flax;

and in considering them I shall endeavour less to give the opinions of the individual speakers than to point out the general scientific inferences which may be deduced from the whole discussion; and though two, at least, are mainly occupied with practical details, I think I shall be able to show that even they have a foundation of scientific principles.

1. The first of these subjects of discussion, "On the best modes of housing and feeding fattening stock," naturally divides itself into three different sections, which most of the speakers have considered separately. On the first head, (that of housing,) all refer to the

gradual change which has taken place in the mode of accommodating fattening cattle, and the abandonment of large open courts containing from ten to twenty cattle, and the introduction, first of hammels or small courts, with sheds for the accommodation of two or at most three cattle, then of stalls, and still more recently of boxes. The concurrent testimony of all is strongly condemnatory of the first of these practices, and reference is very distinctly made to the scientific facts on which its inferiority depends. It has been conclusively established by scientific inquiry, that the natural temperature of the animal body is sustained by the consumption of a certain quantity of its food, which during the process of respiration undergoes a change chemically identical with that which takes place in the act of combustion. But in the animal body the temperature is always the same, whatever be that of the surrounding air. If, for instance, an ox be examined, its temperature will be found by means of the thermometer, during the dead of winter and the height of summer, to be always the same; and on Fahrenheit's thermometer it will be somewhere about 100 degrees, while that of the air may in the one case be under the freezing point, and in the other as high as 70 or 80 degrees. Now it is very obvious that, in the former case, a much larger quantity of food must be consumed, to sustain the temperature of the animal at 100 degrees, than is necessary in the latter—just as a room requires more fire to keep it hot in the winter than during the warmer seasons of the year; and it naturally follows, that if we keep the animal in a warm locality, we economise the fuel, and require to supply a less quantity of food to keep up the temperature of its body at the natural standard. Now this is exactly what is effected by the improved methods of housing cattle; for while, in the large open court formerly universally employed, they were exposed to every vicissitude of the weather, in the smaller courts with sheds, or still more in houses, they are protected from the extremes of temperature, and an economy of food effected. A certain quantity of food is capable, under favourable circumstances, of producing a certain quantity of fat: but if the temperature of the air falls, an additional quantity of fuel is required to sustain the animal heat; and science has shown that the elements so consumed, or burned off, are exactly those which, under any circumstances, would go to the formation of fat. It is obvious, therefore, that if we keep the animal warm, we do what would otherwise be done by a portion of the food with which we supply it; and we might be inclined to say that the warmer it is kept the better. But practically there is a limit to this: there is a certain range of temperature which is natural to the animal; and though, in the process of fattening, we place it to a certain extent in an unnatural condition, we cannot carry this too far without producing various derangements of the system, which would speedily end in positive disease. Our object, therefore, must be to sustain only a certain proportion of

the internal temperature by external warmth; for the production of a considerable part of it, by the combustion of the food within the body, is connected with and essential to the healthy performance of the animal functions.

But there is another source of waste of food which these improved means of housing are also calculated to prevent. It has been ascertained that not only is the temperature sustained at the expense of the food, but that every movement of the muscles produces also a certain consumption of it. Thus, if we sit still for an hour, a certain amount of the food we have swallowed is consumed or burned off in our bodies, which can actually be measured, by particular and very complicated chemical experiments; but if we run violently, or engage in any active muscular exertion, the quantity which undergoes combustion is greatly increased. Now, obviously, if we confine a number of cattle in a large court-yard, which admits of abundant exercise, we produce the conditions of an increased and uneconomical consumption of food; while, if we confine them in a small space, we diminish the muscular exertion, and consequently the amount of food which is wasted by it. And this is what is actually carried into effect by the use of hammels, stalls, and boxes, which, by the smallness of their space, prevent the animal taking an undue amount of exercise. In this, however, as in the former case, there is a limit, for exercise to a certain extent is absolutely requisite to the healthy performance of the functions of the animal.

The object, therefore, of the careful feeder, is to reduce the consumption of food, by these two necessary processes, to the smallest quantity consistent with the perfect health of the animal; and I need hardly say that practice is here fully consistent with theory, for the speakers, one and all, concurred in upholding the superiority of the methods adapted to secure these results, while they all condemn the use of open courts, which expose the cattle to the vicissitudes of the weather, and admit of active exercise. Minor differences of opinion, however, exist as to which of the other methods of housing presents the greatest advantages; but those differences, as Mr Elliot remarks in his observations, may be readily and fairly attributed to differences of climate and locality; for while hammels, which permit a certain amount of exposure to the weather, may be quite successful in a low and sheltered locality, they may be equally unsuited to an upland and cold district. The balance of opinion, however, is in favour of box-feeding, which is well spoken of by all those who have given it a fair and extended trial. It fulfils, in fact, all those conditions to which we have just referred, and possesses the important practical advantages of economy in the expenditure of labour in feeding, and the production of a manure of superior quality. This superiority of manure, though referred to by several speakers, is not discussed in detail; nor, so far as I know, are there at the

present moment any satisfactory experiments to substantiate it; and though I think it probable that a certain degree of superiority is produced, I should, on theoretical grounds, hesitate to express a decided opinion. It is most desirable, however, that we should obtain facts which may enable us to do so, and I would suggest the subject as one which merits examination by careful experiment on the farm.

The second part of the subject—the method of feeding—was not gone into in such full detail as it was at one of the discussions of the previous year, but various observations fell from the different speakers which are deserving attention. Mr Elliot insists, particularly, on the advantage of giving a considerable variety of food; and this, which is his opinion, founded on actual experience, is fully borne out by science, and is peculiarly interesting to me, as I have more than once referred to it, on scientific grounds, as a proper practice; for, theoretically, the more we can vary the forms in which the elements of food are supplied to the animal, the more likely are we to promote active and healthy digestion, as well as to hit the proper proportion in which these different constituents ought to be present. It has been established that there are two great classes of compounds which the food must contain, one of which, including the saccharine and oleaginous substances, forms the true fuel of the animal body, of which one part goes to sustain its temperature, while another is laid up in the system in the form of fat, to be used as fuel in any emergency to which the animal may at a future period be exposed. The other class includes what chemists call the albuminous or proteine compounds, which go to the production of the true flesh or muscular fibre. Now, the successful fattening of the animal can only be effected by supplying it with food, which contains both classes of constituents in certain proportions. All the substances employed in feeding are not of this kind, and we require, therefore, to mix them together, so that the deficiencies of the one may be made up by another. Mr Christie has given us a curious illustration of this. On one occasion, when beans were extremely cheap, he gave 6 lb. each to a lot of sixty cattle, and he found that for several months they did well; but about the end of that period their coats became rough, they appeared not to relish their food, and some of them refused it entirely. In this case there was supplied to them a quantity of food, rich in albuminous, but deficient in saccharine or oily elements, and the proper proportion of these two being thus deranged, the functions of the animal were imperfectly performed; but no sooner did Mr Christie reduce the quantity of bean-meal to 2 lb., and substitute for the remainder 4 lb. of oilcake, than they immediately began to improve, and were soon sold in excellent condition. But even when the proper proportion is preserved, much advantage must be derived from varying the food, because the albuminous, oily, and saccharine matters are not chemically identical in all;

and it is consistent with all we know of the phenomena of nutrition, to afford to the animal a supply of them in as varied forms as we can.

Mr Elliot, in referring to the possibility of profitably employing the grain produced upon the farm in feeding, has touched on a subject of much importance, and which has engaged a good deal of my attention. He has given an illustration from his own practice of a case in which, after allowing a proper price for the turnips and grass consumed, he obtained 3s. per bushel for his oats, and 4s. for his beans, at a time when the market prices were 2s. 3d. and 3s. 4d. respectively. If such profits could always be obtained, there could be no hesitation in adopting the practice; but I confess I cannot help thinking this to be an extreme case, though I am at the same time convinced, from a comparison of the nutritive value of those substances, that better profits may often be obtained in this way, when prices are low, than by sending the grain to market. I shall not attempt here to state the grounds of this opinion, as the full discussion of the subject would occupy much time, and lead me altogether away from the matter in hand.

In referring to the last branch of this discussion, (that of the best breeds of cattle,) I approach a subject very foreign from my pursuits, and of which I must simply profess my ignorance. But I may be permitted to offer one or two observations, which naturally suggest themselves to any one hearing the remarks of the speakers. I need scarcely say that the short-horn receives the general support, but it is easy to see that its peculiar advantages open up a question, which may have the effect of producing a very important change in agricultural practice. In fact, if the farmer goes into the market for the purpose of buying cattle for feeding, it does not much matter what breed he takes, provided he gets them cheap enough to leave him a profit on his expenditure of food and labour; but it is quite another thing if he breeds the animal himself, for in that case the advantage is enormously in favour of the short-horn, from the rapidity with which it arrives at maturity, and its disposition to lay on fat. Mr Wilson, who refers to this fact, gives some interesting illustrations of it, which, however, do not admit of being curtailed. It would appear that this early maturity is peculiar to the short-horn, but it may be asked whether this is necessarily the case? and, also, how far their treatment produces this superiority over the other breeds? The short-horn, as the superior breed, is bred in the best districts, nurtured with every care, and supplied with abundance of nutritious food: contrast this with the Highland breed, for instance, passing its early life on an exposed hillside, and fed on its scanty herbage—the one placed in circumstances to force it on to early maturity, the other in those to repress it, and even to stunt its growth; and the question presents itself, as to what would be the effect of affording to

the latter the same generous treatment which the former receives. It seems to me quite possible that the inferior breeds might acquire the peculiarity of arriving at early maturity in a greater or less degree. Perhaps such experiments may have been made already; but if so, I have not chanced to meet with any account of them.

2. Of the second discussion (that on "Turnip Culture") I fear I shall be able to give only a very unsatisfactory account, the statements of the speakers entering into all the minutiæ of the methods of cultivation, with a fulness of detail which renders the discussion very interesting to those who are inclined to study it in full, but makes the task of abstracting it very difficult indeed. I shall not, therefore, attempt to go into all the particulars of the preparation of the soil, which I should certainly fail to make interesting to you, but shall confine myself to such points as appear to me to lead to scientific inferences. The turnip crop has now become so essential a part of our system of husbandry, that it is with a strange feeling we look back, and find that its cultivation as a field crop dates from no more distant period than the middle of the last century, while so important has been its influence, that its introduction has, without doubt, produced a revolution in agriculture as rapid and as remarkable as that occasioned by the steam-engine in the mechanical arts. The turnip is interwoven with the whole history of agricultural progress; it is the pioneer of improvement, and the foundation of good cultivation, and that to so great an extent, that we should not err greatly if we take the proportion of land under turnip as the measure of the agricultural condition of any district. It would be very interesting, in this point of view, to trace the gradual rise of its cultivation. In the absence of agricultural statistics it is unfortunately impossible to do so, but facts enough are adduced by some of the speakers to show that, during the last fourteen years, (the period of remarkable agricultural progress,) the breadth of land in Scotland under turnips has doubled. But even this does not express the full advance, for there is no doubt that the average crop per acre has also increased in no inconsiderable degree. Mr Elliot has given a very interesting statement of what has been done in Annandale, during the last few years, through the instrumentality of Mr Stewart of Hillside, which may enable us to form some idea of the extent to which this has occurred. In 1842, a series of queries was issued by that gentleman requesting information regarding the turnip crop; and from the answers received, it appeared that the average crop of swedes that year amounted to 13 tons per Scotch acre. In the subsequent years, a committee of the Lockerbie Farmers' Club went round and weighed the crops on the different farms, and from their returns found that in 1849 the average had risen to 21 tons; in 1850, to 24; and last year, notwithstanding the extensive prevalence of finger-and-toe, it still amounted to about 20 tons. Here

we have an increase on a very unfavourable year of upwards of 50, and on a favourable one of nearly 100 per cent.

If we proceed upon these data, it would appear that the quantity of turnip produced is nearly four times as great as it was fourteen years ago. It is probable, however, that we should in this way considerably exaggerate the increase, for the plan followed by the Lockerbie Farmers' Club would necessarily be a great incentive to good cultivation, and produce a rapid improvement and a high average; the district, moreover, was then a backward one, and it can scarcely be assumed that so great an increase can have occurred in the Lothians and other well-farmed districts. Be this as it may, the fact of a very considerable increase having unquestionably occurred in the average crop, irresistibly impresses us with the idea that we have by no means reached the limit of production, but that we may confidently anticipate the possibility of producing still larger crops. Mr Hope of Fentonbarns has entered into a very interesting calculation to show the possibility, nay, the probability of this. He calculates that there are in round numbers 8000 lineal yards of drills, 27 inches apart, in a Scotch acre. Now, if we suppose there to be 3 turnips per yard, and each to weigh 2½ lb., the total crop would amount to about 27 tons, which is above the average. But when we bear in mind that it is no uncommon thing to see turnips of 10, 12, or 16 lb. weight, it is surely not extravagant to suppose that we might produce an average of 4 or 5 lb.; or, in other words, obtain crops twice as large as we at present do. The question which immediately presents itself is, How is this to be done? For my own part, I do not anticipate its being immediately effected—indeed, I do not think we are entitled in any case to expect rapid advancements in agriculture. They may occasionably occur, when we have the successful introduction of a new crop, but as far as the after-improvement of it goes, we must be content to wait patiently, to watch what is going on, and to adopt any little improvement which time, experience, or science may produce. This, which is true of every crop, is particularly so of the turnip, the successful cultivation of which is dependent on attention to minutiæ. There are two great points which practice tells us we must attend to, and theory also confirms. We must reduce the soil to the finest possible tilth, and manure plentifully with rapidly-acting manures; and we have only to consider the natural state of the turnip to see how essential these conditions must be. As it grows wild, the turnip produces no bulb at all, or at most a little swelling on its root, which may weigh perhaps an ounce or two; and the object of cultivation is to expand this little protuberance into a bulb of two, four, or, if possible, ten or twelve lb. weight. Now it requires no great amount of consideration to see that, if we wish to succeed, we must plant our seed in a loose soil, which shall

admit of being pushed aside as the root expands; for if we place it in a hard or compact soil, where there is any resistance to the expansion of the bulb, we put it in a manifestly unfavourable condition. It is for this reason that stiff clays are unfavourable to the turnip, and it is the opposite peculiarity which has caused particular soils to be distinguished as turnip soils, the peculiar suitableness of which to the turnip is not dependent on their chemical composition, but on their possessing a light and friable texture, which presents little resistance to the pressure of the bulb. Where the soil does not necessarily possess this peculiarity, we must do our best to make up for the deficiency by repeated working; and that necessity is sufficiently strongly insisted on by all those who have discussed the subject. On the other hand, when we take into consideration the large mass of bulb which is to be produced, and that in a very short time, we understand the necessity of affording a liberal supply of manure, of such sorts as produce their effect with rapidity.

On the subject of manuring little difference of opinion exists, and that only in details. A decided preference is given to guano by all the speakers, and particularly by Mr Hope, who informs us that in his hands it has always surpassed every other manure. Mr Elliot, on the other hand, thinks the admixture of different sorts of artificial manures most advantageous, and states as the result of his practice, that a mixture of farm-yard manure, bones, guano, and superphosphate, at an expense of £4, will produce a better crop than any of them separately, at an expense of £5 per acre. As this subject, however, was more fully taken up at the next discussion, I shall not now refer to it at length.

The great difficulty of turnip culture is the liability of the root to the disease of finger-and-toe; and the extent to which it has increased of late years in some districts, is such as to excite most serious apprehensions. To this subject I have for some time past directed my attention, but without arriving at any positive results, except that it is certainly not dependent upon causes on which the analysis of the turnip itself, or the soil in which it grows, can throw light. In fact, the more minutely we inquire into the matter, the more complicated does it become, and the more conflicting are the opinions expressed. When I commenced the inquiry, I was informed by some persons that lime was a perfect cure, by others that it was totally useless; by some that the disease was certainly produced by an insect, by others that it was certainly not; by some that it is produced by the too frequent repetition of turnips on the same land, by others that it occurs with as great virulence on land under turnips for the first time, as on that in which they have been frequently sown. With such conflicting opinions, I felt that more extended information was requisite to enable me to ascertain whether all these opinions were

equally correct, and whether it might not be possible to reconcile them with one another; and accordingly a schedule of queries on the subject of turnip disease has been widely circulated among the farmers of Scotland, which, I trust, may enable us to arrive at some definite conclusions. In the mean time, it seems certain that lime is, in many instances, unequivocal in its effects, and that benefit is generally obtained by making the turnip recur as seldom as possible on the same land. There is just one observation with which I should wish to conclude, and it is this, that we must be careful lest the importance of the turnip, and the highly beneficial results obtained from it, should blind us to the value of other roots. I am not very sure whether this has not been to some extent the case. We very seldom hear, for instance, of mangold wurzel, although chemically it is more valuable than the turnip. The reason assigned for this is, that it is not suitable to the climate of Scotland; but there are some districts in which it can certainly be profitably raised, and I think there are indications of a tendency to produce it more extensively. Should it prove successful on more extended trials, it would form an important substitute for the turnip, and, by protracting the period of its recurrence on the same land, diminish the risk of disease.

3. The third discussion (on the comparative value in point of economy, immediate and permanent effect of guano and other special manures, and of farm-yard manure produced by turnips alone, or by turnips with auxiliary feeding) relates to a matter of the highest importance to the active and improving farmer. It has, moreover, an additional interest, as being one of those subjects upon which science and practice can meet together on a common ground, and are in the condition mutually to explain and assist each other. The introduction of special manures has indeed been the main-spring of the applications of science to agriculture, and has brought home to the practical man the importance of inquiring, as he goes along, into the principles upon which his art depends; it has impressed him with the advantages of looking more deeply than he has hitherto been accustomed to do into its phenomena, and stimulated him to proceed in the path of improvement. The advantages of guano and other special manures are now so universally acknowledged, that it would not have required the confirmation afforded by all the speakers to establish the fact. The most convincing proof is to be found in the gradual increase which has taken place in their use, so that the consumption of guano, which in 1842 did not reach 1700 tons, has now risen to upwards of 200,000. But while nothing further is required to settle this point, many very complicated questions must be answered before we can form a just comparison of its effects with those of farm-yard manure, which many people were at one time sanguine enough to suppose it was entirely to supersede.

I shall pass over with only a few observations the comparative advantages of the different sorts of special manures, which form a very subordinate part of the present discussion. It appears that general experience has established the superior economy of guano, and particularly Peruvian guano, over all other special manures. This superiority, I may, however, observe, is most prominently marked on the better class of soils, and is not so apparent on those which are light and sandy, on which the inferior sorts of guano, such as Saldanha Bay, and bones, often produce a better effect. This is dependent on Peruvian guano yielding a larger quantity of ammonia and a small quantity of phosphates; and as the former, from its solubility, is liable to be rapidly washed away, the main effect on the lighter soils is due to the phosphates; and the manures most advantageous on such, are those which contain the latter substances in largest proportion, as Saldanha Bay guano and bones do. It is on good, and particularly on highly cultivated land, that the benefits of Peruvian guano are principally seen.

Without entering further into this question, I shall take Peruvian guano as the point of comparison, and endeavour, from the facts brought out by the speakers, to estimate its value, compared with farm-yard manure. Taken in its broadest point of view, this comparison is by no means so easy as it at first sight appears. If we had to consider merely the relative effects of the two manures upon a single crop, there would be no great difficulties; but in order to obtain a complete comparison, it is necessary to estimate the amount of unexhausted residue remaining for the benefit of future crops, which is not easy; and an additional complication is introduced, when the question of price is taken into consideration. As far as the immediate effects of guano are concerned, these can be readily estimated; and it appears from the statements of Mr Finnie, quoted by Mr Dickson, that as good a crop can be obtained from 6 cwt. of guano as from 30 tons of farm-yard manure; while Mr Dudgeon, on his part, finds the same effect from 4 cwt. of the former as from 20 tons of the latter. In those cases, 1 cwt. of guano supplies the place of 5 tons of manure; but Mr Finnie is of opinion that, as a general rule, it would not be safe to reckon on that quantity replacing more than 2½ tons. With these proportions, and upon the turnip crop to which it is applied, there can be no question of the utility, and, as we shall presently see, of the economy of guano, though it is admitted that it is still preferable to employ it not alone, but in conjunction with farm-yard manure. When, however, we come to consider its effects on the subsequent crop, some difference of opinion exists, and doubts are expressed. For my own part, I have no hesitation in giving it as my opinion, that it must be inferior; and though it may be possible, by modifications of practice, to render

its inferiority less than it might otherwise be, it must always exist. It is certainly not the case, as was almost universally supposed at its first introduction, that the whole benefits of guano are exhausted in the first season; still it is essentially a rapid manure, and leaves comparatively little for subsequent crops. The unexhausted residue is dependent to some extent on the nature of the soil, and is much larger when that is heavy than where it is light; but under no circumstances is it at all comparable with that left by farm-yard manure. This becomes very evident, when we compare the quantity of valuable matters supplied to the soil by an ordinary manuring with both these substances.

Thirty tons of farm-yard manure, which is a liberal supply, will contain, in round numbers, about 260 lb. of nitrogen—equivalent to 310 of ammonia, and about 450 lb. of phosphates. But 6 cwt. of Peruvian guano, which is a larger quantity than is usually employed, even when no other manure is used, contain only 103 lb. of ammonia and 132 lb. of phosphates. Now, a crop of turnips amounting to 20 tons contains a quantity of nitrogen corresponding to about 108 lb. of ammonia, and about 110 lb. of phosphates; and it is therefore obvious, that at the end of the first season there would remain no ammonia, and only about 22 lb. of phosphates, available for future crops; while in the case of the farm-yard manure, we should still have about 200 lb. of ammonia and 340 lb. of phosphates remaining for future use. It may be urged that, if this calculation be correct, the crops following turnips raised with guano ought to be total failures; and they would be, were not their valuable matters obtainable from other sources than the manure we apply. An acre of good soil, in fact, contains from 1 to 2 tons of nitrogen, and about the same amount of phosphoric acid, and from it a certain quantity of what passes into the plant is taken, but not the whole, for they exist in the soil in a condition in which they are only slowly available; and in all cases where manure is supplied, a larger proportion will be taken from it rather than from the soil.

Notwithstanding this, I have no doubt it may be possible to go through a complete rotation with guano alone; and Mr Dickson has given us an interesting case in which this was managed with a mixture of guano, dissolved bones, rape-dust, nitrate of soda, and sulphate of ammonia; but I question much whether it could be successfully carried out through a series of several rotations, even if we took care to add all the valuable matters removed by the crops; and the reason is, that farm-yard manure not only adds the constituents which the crop has removed, but has another function to perform on the soil itself, the importance of which we are apt to overlook. It is a source of carbonic acid, which is being gradually evolved by the fermentation which is constantly going on in it; and that carbonic acid acts slowly upon the mineral part

of the soil, decomposes and disintegrates it, and brings its constituents into a state in which they are available to the plant. A similar change is also occurring in the organic matter existing naturally in the soil, which will keep this disintegration going on for a certain time, even where no organic matters are added in the manure; but after the lapse of a longer or shorter period, this will be exhausted, the soil itself become comparatively inert, and the plants which grow upon it entirely dependent on substances added from without, and of which a very large supply must be given. In Mr Dickson's case, the soil was rich in organic matters, like all those around Edinburgh; and in the previous rotation it had received no less than 40 tons of farm-yard manure, which may help to explain his success, and may fairly entitle us to surmise that a very different result might be obtained if the same practice were continued through a series of rotations. Indeed, it might be easily shown that the crops in this case must have carried off more nitrogen than they receive in the manures employed, and they must, consequently, have been abstracting it from the soil, the consequences of which must, sooner or later, become obvious.

It may probably be said, that if the statements I have made are correct, that guano, far from being beneficial, ought, in the long-run, to be inferior to farm-yard manure; and it would certainly be so, if we depended upon it alone. Its peculiar advantages are as an auxiliary, which supplies a quantity of certain constituents in an immediately available condition, in which they are requisite for producing the rapid growth of the crop through the early stages of its existence; and the enormous mass of farm-yard manure which must be used where large crops are expected, is dependent to some extent on the small quantity of its constituents which exist in that condition; so that we generally employ a larger total quantity of the valuable constituents of farm-yard manure than is required for the whole rotation, merely that, by doing so, we may get a sufficiently large amount of those which we wish to act rapidly. The peculiar merit of guano is, that, by mixing it with farm-yard manure, we can bring up the quantity of immediately available constituents, without adding unnecessarily to those which are to be long dormant in the soil. The practical fact is, that under liberal management, by farm-yard manure alone, a soil becomes gradually richer in organic matter, ammonia, and phosphates; and it is quite possible, so long as that excess remains, to raise crops by the addition of the rapidly-acting manure alone; but it is a system which the good farmer will only employ under exceptional cases.

On that part of the subject of discussion which refers to the comparative value of manure produced with or without auxiliary feeding, we have little precise information. A vague general opinion seems to exist, that the use of oil-cake, and other foreign food,

does improve the manure; but no experiments are supplied except by Mr Main, who found that a quantity of manure, produced by auxiliary feeding, gave an excess of 3 tons 9 cwt. of turnips over a similar quantity without it. The experiment, however, is a solitary one; and I do not think it desirable to draw very decided conclusions from a single experiment in such a case.

In what I have now stated, I have alluded merely to the comparative effects produced by quantities of the different manures; but when we come to the question of actual economy, we get into a new complication. The difficulty which meets us is, that while guano and special manures generally have a fixed market price, the cost of farm-yard manure is purely conventional, and differs greatly in different districts. The only two of the speakers who have attempted to determine its price, are Mr Dickson and Mr Dudgeon; and the former estimates it, including the cost of application, at 8s.; the latter at 5s. per ton. The latter estimate is founded on the price at which dung can be bought in the neighbourhood; and though Mr Dickson does not state the grounds of his calculation, I presume it is similar. Now, I think the estimate ought to differ according to circumstances. Suppose a farmer finds that he is unable to produce upon his farm as much manure as he requires, ought he to make up the deficiency by purchasing guano or farm-yard manure? There can be no hesitation in deciding in favour of guano. For, on Mr Dudgeon's estimate, we must pay for 20 tons of manure £5, and on Mr Dickson's £8, while 4 cwt. of guano, which may be substituted for it, may be bought for £2. But the question is different if he can produce as much manure on the farm as he actually requires. He is not then entitled to estimate his farm-yard manure at the rate at which it may be purchased, but at the cost of production; and it is in estimating this that the great difficulty is experienced. In fact, a habit has crept into agriculture, which I think extremely objectionable, of estimating the value of the manure, by assuming that a certain fraction of the food of the cattle remains in it, and the cost of this part of the food is withdrawn from the expense of feeding the cattle, and taken as representing the cost of producing the manure. I must confess I have always been of opinion that there is no way in which a farmer is more likely to deceive himself; the proportion of the food which is thus to be referred to the manure-heap being mere guess-work, unsubstantiated by experiment, and generally over-rated; as, for instance, when we hear of one-third of the price of oilcake being debited to the manure. It would be much wiser to ascertain the expenses of feeding, irrespective of the manure-heap, and then, of course, if there is a profit upon it, the manure is got without cost, and nothing but the expense of application is to be estimated; if, on the other hand, there is a loss, that loss is the cost of production of the

manure, and it must be the object of the farmer to see that it does not exceed the price at which farm-yard or artificial manures can be purchased.

As far as the manure produced by auxiliary feeding goes, Mr Main pronounces against its economy, and calculates that in the experiment before alluded to, he lost 17s. 2d. per acre, although the produce of turnips was increased by 3 tons 9 cwt.; but his estimate is founded on the assumption that one-third of the cost of the oilcake must go to the manure, although he does not himself consider it fair. The proper plan would have been to have stated also the profit or loss upon the cattle; for if there was a profit equal to that upon those fed without oilcake, then, of course, there was a direct gain of 3 tons 9 cwt. of turnips, worth about £1, 5s. On the whole question, theory and practice concur as to the advantages of light manures; but they must be judiciously applied, and must be used only as auxiliaries, and not independently of farm-yard manure.

4. With the last discussion, that on flax culture, I shall not detain you very long; not that it is less important than those which have preceded it, but because it consists of statements which must be read in full to be appreciated, and which have, moreover, already appeared in a more extended form in the Transactions of the Society, and have been honoured by premiums. These statements are well deserving of attention, as they contain the most precise and satisfactory information we as yet possess regarding the recent cultivation of flax in Scotland. I need not inform you that, though once cultivated to some extent in Scotland, flax had been almost entirely abandoned until within the last few years, when the altered circumstances of agriculture again directed the attention of farmers to it, and induced the inquiry as to whether, with the low prices of grain, it might not again be profitably introduced into the rotation. This inquiry has obtained additional importance from the introduction of processes which, by replacing the old method of steeping the flax, have produced a market for it in the straw, and have relieved the farmer of a process very different from those to which he is accustomed, always attended with much trouble, and often with uncertainty and loss. It may, indeed, be safely laid down as a rule, that in a country where labour is dear and rents considerable, the old process can scarcely be made to pay, except under the most favourable circumstances. But we know very well that the process of retting as it used to be practised is extremely uncertain, and its success dependent upon the nature of the water, the uniformity of temperature and steadiness of weather, and upon various little precautions, inattention to which may deteriorate the fibre to such an extent, as to make it comparatively worthless. In short, if flax is to pay now, it must be with the assistance of these new

processes, and no farmer will act wisely who attempts its cultivation, except in localities where he has ready and cheap access to establishments in which they are performed.

The evidence brought forward at the meeting certainly went to prove that, where this can be managed, the profits derived from the flax surpass those of a crop of oats,—Mr Hodgson, on his first year's trial, having found an advantage of no less than £4, 5s. 8d. per acre in favour of the former; and though so great a difference was probably due to exceptional causes, and is not found in the subsequent year, there is still a very decided superiority on the side of the flax. It has always been urged as a great objection to flax, that it removes from the land a larger quantity of mineral matters than any other crop; but the chemical investigation of the plant shows that there has been much misapprehension on this point, and that under proper management it does not exceed, if indeed it does not considerably fall short of, other crops in this respect. It has been thoroughly established that, with flax as with other crops, the principal part of the valuable constituents are accumulated in the seed, and comparatively little in the straw. Now, it has been found by experience that the finest quality and most valuable fibre is obtained when the flax is cultivated under such circumstances, that its production of seed is as small as possible. This is effected practically by sowing close, and by avoiding too large a supply of manure, which has the effect of producing a coarse and inferior fibre. If this system be pursued—and it is manifestly that which for all reasons must be most profitable—flax cannot be considered more exhausting than a white crop. I am assuming, of course, that, as used formerly to be the case, both straw and seed are removed from the land; but if, as will probably henceforth be practised, the seed be employed for feeding on the farm, I apprehend it will turn out to remove less valuable matters than a crop of oats, of which the seed is removed, and the straw returned to the land. Such, at least, is the inference to which science would lead us, but it would be most desirable to have it confirmed by actual experiment; and the gentlemen who have gained the Society's premiums would do a further service to agriculture, if they would make public the results obtained from the subsequent crops, in the rotation in which their flax was grown. Mr Reid, indeed, has given us the result of a bean crop immediately following the flax, but with an application of 25 tons of farmyard manure, in which they surpassed those following oats by no less than £1, 18s. 4d.; but it would be unwise to draw general conclusions from a single experiment, and, for my own part, I do not anticipate that any difference will be found; but even if there were a slight difference in the opposite direction, I do not think that, in the advanced state of agriculture, the farmer ought to be deterred by it, or that there would be any deficiency

which might not be easily made up by a slightly more liberal treatment afterwards. An important advantage of flax is, that it appears to be best produced in soils of somewhat inferior quality; at least it is certain that too rich a soil is injurious, as, by promoting too luxuriant a growth, it produces a coarse fibre, and greatly diminishes its value. In fact, success appears to be best obtained on a soil which is not too rich, nor too dry, and which is reduced to a fine tilth, and is sufficiently deep.

The cultivation of flax has received a great impetus from the improved methods of steeping; and though the farmer ought henceforth to have nothing to do with that process, he must naturally feel interested in it, as every improvement must in the long-run tell to his advantage. The process now generally employed is that patented by Schenck, and it is extremely simple in principle. It consists in placing the flax straw in small vats, in which it is covered with water kept at a uniform temperature of 90 degrees, by a steam-pipe passing through it. The flax is exposed to this treatment for a period of from sixty to seventy hours, and, at the end of that time, the process of fermentation is complete, and the fibre can be separated from the husk and other parts. There is no question that this process is a great improvement, but I have no doubt that it is yet in its infancy, and that it is still far from perfect. I happen to know that a patent for steeping flax upon another plan is also about to be taken out, the preliminary experiments on which have, I am given to understand, been most successful. Other processes have also been proposed; and one—that of the Chevalier Claussen—has been introduced to the public with great flourish, and great results are expected from it, but which, I must confess, I do not think will be realised. That patent, as you are probably aware, is for a method of converting flax into a substance like cotton, which is done by a somewhat complicated process. Now, if the patent had been for converting cotton into flax, I should have understood it, for that would have been converting a cheap material into a dear one; but I cannot see how anything is to be made by converting a dear substance into a cheap one. If it is meant that inferior qualities of flax are to be converted into fine cotton, we can just conceive the possibility of its paying; but if that is all that is to be done, it can be of no benefit to the farmer, because he may depend upon this, that if he is to make the cultivation of flax pay, he must aim at producing only the superior qualities.

I have thus, gentlemen, endeavoured, as fully and fairly as I could, to bring under your notice the most important parts of these discussions. I fear that, in my desire to avoid prolixity, and to compress my address within reasonable limits, I may have omitted many points worthy of more extended notice, but I trust I have said enough to justify the statement with which I set out, that

these meetings were well deserving of public attention. Their peculiar interest is, that while they point out the present state of our knowledge, they indicate also those matters on which our information is still deficient, and are full of observations which serve to show where experiment is required to add to or elucidate it. I have endeavoured, to the best of my power, to bring these distinctly before you; and, though I am conscious of many deficiencies in the manner in which I have executed my task, I trust they may be excused. I might, perhaps, have selected a more entertaining subject, and with much greater ease to myself, but I conceived it would be best to occupy your time with something connected with the general business of the Society.

PROCEEDINGS IN THE LABORATORY.

By Thomas Anderson, M.D., Chemist to the Highland and Agricultural Society.

ON THE COMPOSITION AND COMPARATIVE VALUE OF DIFFERENT SORTS OF CLOVER.

The frequent failure of the red clover crop has of late years directed attention to the cultivation of other varieties of clover; and some of these have been introduced to a considerable extent, and probably would be still more largely cultivated, were it not for the difference of opinion which exists among practical men as to their comparative values. These differences of opinion were brought conspicuously before me by the observations made at one of the monthly meetings of the society, at which yellow clover was as strongly approved of by some as it was condemned by others; and the desire to ascertain which of these opinions was correct, or whether they did not admit of being reconciled, induced me to undertake comparative analyses of the two species, and at the same time to extend the investigation to several other varieties, a knowledge of the composition of which, I thought, might prove of interest to the farmer.

The clovers employed for analysis were raised from authentic specimens of seed, supplied by Messrs Lawson; and as the analyses were intended to be strictly comparative, it was thought best that they should be grown under precisely similar circumstances. They were, therefore, sown in small patches in a garden soil of fair quality, in Messrs Lawson's nursery; and this plan was adopted because it seemed likely to lead to more uniform results, and to exclude many sources of fallacy which could not fail to be introduced, if specimens had been collected from different fields, in which they might have been cultivated under very different circumstances. It may possibly be objected that the specimens thus obtained are in a condition very different from that in which they are raised in the field; but a very little consideration will be sufficient to show that this objection can scarcely be a valid one.

It would certainly be so, had my object been to compare the relative produce per acre of the different sorts, which would in all probability have led to results very different from those obtained in the field; but my aim being to determine merely the comparative abundance of valuable constituents, in equal weights, of the different plants, this difficulty disappears; for I have found, as a general rule, that though a superior soil produces a more luxuriant growth, and consequently a larger produce per acre of any crop, it does not materially, if at all, increase the quantity of valuable matters which a given quantity of the crop will contain.

The analyses embrace different varieties of red clover, (*Trifolium pratense*,) cow-grass, (*Trifolium medium*,) crimson clover, (*Trifolium incarnatum*,) yellow clover, (*Medicago lupulina*,) Alsike clover, (*Trifolium hybridum*.) They were intended to have included also white clover, but for some reason or other these were not grown at the same time. Of some of these species several different specimens were grown, as varieties exist which present well-marked differences in their habit of growth, and other peculiarities, which enable the practised eye to determine at once with considerable certainty the source from which the seed was obtained, and are very obvious to any one when they are pointed out. The selection of these samples was intrusted to Mr Lawson, whose experience enabled him to choose those which present the most marked differences, and are of the highest practical importance. The plants were collected as soon as they came into full power, which occurred with the crimson clover early in August, but with the others not till the middle of September.

The method of analysis consisted in determining the amount of water in the moist plant, which was done by weighing off a small quantity, carefully selected, so as to give a proper average, and drying it at the temperature of 212°, which required from eight to twelve days. The dry residue was then employed for the determination of the per-centage of ash and of nitrogen, and the quantity of these in the moist substance obtained by calculation. An attempt was also made to determine the quantity of oil, which proved to be excessively small; but the presence of Chlorophyle, the green colouring matter of plants, which cannot be separated from the oil, complicated the results so much that I was induced to abandon the attempt, which appeared to me likely to lead to fallacious results, the more especially as the quantity was so small as to be comparatively unimportant. The remainder of each sample was dried and burned in a platinum basin to yield the ash which was analysed in the usual manner. In detailing these analyses, I have given both the actual results of the experiment, and the numbers, calculated without the carbonic acid, the small variable amount of charcoal, which is always left unconsumed, however carefully the plant may have been burned, and the sand which cannot be separated from the plant before burning. The experi-

mental results are contained in the first,—the calculated in the second column of the analyses.

No. 1.—*Red Clover from English seed.*

Water,	85.30
Dry residue,	14.70
Ash in 100 parts of wet substance,	1.30
Nitrogen in do.,	0.37
Ash in 100 parts of dry substance,	8.90
Nitrogen in do.,	2.54

Analysis of ash.

	No. 1.	No. 2.
Silica,	1.82	2.39
Peroxide of iron,	1.18	1.54
Lime,	20.05	26.32
Magnesia,	7.88	10.34
Sulphuric acid,	2.75	3.63
Phosphoric acid,	3.81	5.01
Chloride of sodium,	5.44	8.45
Chloride of potassium,	8.45	11.08
Potash,	23.81	31.24
Sand,	6.92	
Charcoal,	0.24	
Carbonic acid,	16.79	
	100.15	100.00

No. 2.—*Red Clover from seed grown in the Rhine district of Germany.*

Water,	81.68
Dry residue,	18.32
Ash in 100 parts of wet substance,	1.49
Nitrogen in do.,	0.45
Ash in 100 parts of dry substance,	8.15
Nitrogen in do.,	2.48

Analysis of ash.

	No. 1.	No. 2.
Silica,	2.18	2.86
Peroxide of iron,	1.37	1.81
Lime,	19.75	25.98
Magnesia,	7.65	10.05
Sulphuric acid,	2.99	3.93
Phosphoric acid,	6.25	8.22
Chloride of sodium,	7.67	10.08
Chloride of potassium,	4.43	5.83
Potash,	23.76	31.23
Sand,	8.15	
Charcoal,	0.10	
Carbonic acid,	15.70	
	100.01	100.00

No. 3.—*Red Clover grown from seed from the North of France.*

Water,	83.51
Dry residue,	16.49
Ash in 100 parts of wet substance,	1.95
Nitrogen in do.,	0.36
Ash in 100 part of dry substance,	11.82
Nitrogen in do.,	2.17

Analysis of ash.

	No. 1.	No. 2.
Silica,	1.069	1.433
Peroxide of iron,	0.828	1.204
Lime,	25.569	34.286
Magnesia,	9.400	12.605
Sulphuric acid,	2.789	3.650
Phosphoric acid,	6.336	8.496
Chloride of sodium,	2.071	2.777
Chloride of potassium,	9.022	12.098
Potash,	17.488	23.451
Sand,	4.201	
Charcoal,	0.434	
Carbonic acid,	21.030	
	100.237	100.000

No. 4.—*Red Clover grown from American seed.*

Water,	79.98
Dry residue,	21.02
Ash in 100 parts of wet substance,	1.58
Nitrogen in do.,	0.46
Ash in 100 parts of dry substance,	8.05

Analysis of ash.

	No. 1.	No. 2.
Silica,	2.03	2.673
Peroxide of iron,	1.17	1.413
Lime,	20.24	26.753
Magnesia,	6.80	8.974
Sulphuric acid,	2.66	3.502
Phosphoric acid,	3.06	4.030
Chloride of sodium,	3.50	4.621
Chloride of potassium,	14.38	18.944
Potash,	22.09	29.090
Sand,	8.02	
Charcoal,	0.03	
Carbonic acid,	15.66	
	99.64	100.000

No. 5.—*Red Clover from Dutch seed.*

Owing to an accident, the determination of the water in this specimen was lost; I am therefore only able to give the results on the dry substance.

Ash in dry substance,	8.82
Nitrogen in do.,	1.99

Analysis of ash.

	No. 1.	No. 2.
Silica,	0.971	1.313
Peroxide of iron,	1.099	1.470
Lime,	25.810	34.908
Magnesia,	9.003	12.176
Sulphuric acid,	2.749	3.718
Phosphoric acid,	5.426	7.352
Chloride of sodium,	8.204	11.096
Potash,	18.427	24.928
Soda,	2.247	3.039
Sand,	5.029	
Charcoal,	0.723	
Carbonic acid,	20.084	
	99.972	100.000

A comparison of these analyses indicates a considerable difference in the nutritive value of the different samples. This is particularly seen when we compare the proportions of solid matters and of nitrogen they contain, which may be considered as affording a pretty fair criterion of their value as food; the former indicating the total amount of all the nutritive matters present; the latter giving, of course, the quantity of nitrogenous matters, which are by much the most important—so much so, indeed, that some distinguished chemists have even conceived that the other constituents may be neglected in determining the relative nutritive values of different substances. If we exclude No. 5—which, from the non-determination of the proportion of water, does not admit of being compared in this way with the others—we find Nos. 2 and 4 nearly equal in value, and decidedly superior to the other two, and the difference is most marked between No. 1 and No. 4. While the former of these contains only 14.70 per cent of solid matters, the latter contains 21.02, or nearly half as much again. A similar, though not quite so great a difference exists between the amounts of nitrogen, which are in the proportion of 0.37 to 0.45, or nearly as 4 to 5. It is interesting, however, to observe that this difference holds good only between the moist plants, and that the proportion is reversed if we compare the substances in the dry state; for 100 parts of the dry substance of No. I. contain 2.54 per cent of nitrogen, and of No. 4, only 2.35. An important practical inference is to be deduced from this fact; for it is manifest that the choice which is to be made between them must depend upon the state in which they are compared. I shall best make this intelligible by supposing that a farmer had it in view to purchase a certain quantity of *clover grass* and of *clover hay*—suppose 100 tons of each. Then, in the former case, he would obviously select No. 4; because in his 100 tons of the fresh clover he would obtain in No. 4 nearly half a ton of nitrogen, and in No. 1 little more than one-third; while, if he were to purchase the hay, he would choose No. 1, because the difference would be in its favour. What the precise difference would be can-

not be exactly stated, because the analysis was made upon the absolutely dry substance, while hay, though we call it dry in ordinary language, still contains several per cent of moisture. I have assumed, also, the existence of a hay containing nothing but red clover, which is practically never produced in Scotland; but it will be understood that this is done merely to bring distinctly out the fact that the relative values of two substances may be different, according as they are compared in the dry or the moist state. A comparison of the analyses of the ashes yielded by the different samples also shows considerable differences, which particularly affect the proportion of lime and of chlorine, potash and phosphoric acid. These differences will be made apparent by the following table, containing the proportions of these substances, arranged so that they may be easily compared.

	1.	2.	3.	4.	5.
Lime,	26.32	25.98	34.28	26.75	34.90
Sulphuric acid,	3.63	3.93	3.65	3.50	3.71
Phosphoric acid,	5.01	8.22	8.49	4.03	5.42
Chloride of potassium,	11.08	5.83	12.09	18.94	
Potash,	31.24	31.24	23.45	29.09	24.92

Two of the specimens contain a quantity of lime greatly larger than the others; but, what is interesting, this is unaccompanied by any increase in the sulphuric acid, which has been often supposed to vary with the lime, with which it is considered to be in combination. The variations in the phosphoric acid and potash are also extremely large—those of the latter especially, when we bear in mind that we must compare the total quantities of potash—of which part exists as potash, and part as chloride of potassium—in all, excepting the last, (No. 5,) in which none of the latter compound is found.

I think it necessary to observe that, while these analyses indicate great differences between different samples of red clover, it must not be supposed that they establish the superiority of one or other variety. To do so, an extended series of analyses of specimens of each will be required, as it is necessary to found, not upon one, but upon the average of several analyses. I may observe, in passing, that it would be of much importance to determine how much of the nutritive value of the different samples may be dependent upon the constituents of the ash; if, which is probable, only a small part of it be so, then we ought by preference to select those samples which take up the smallest proportions of the rarer and more valuable constituents of our soils. Thus, for instance, we should select No. 4 in preference to No. 2, because, though the total quantity of inorganic constituents which each will remove from the soil will be nearly equal, the amount of phosphoric acid in No. 2 will be more than double that in No. 4.

Two specimens of cow-grass (*Trifolium medium*) have been

analysed, both from English seed; the first considered to be very fine, the second an ordinary quality.

No. 6.—*Cow-Grass, Duke of Norfolk.*

Water,	77.39
Dry residue,	22.61
Ash in 100 parts of wet substance,	2.73
Nitrogen in ditto,	0.36
Ash in 100 parts of dry substance,	12.09
Nitrogen in ditto,	1.63

Analysis of Ash.

	No. 1.	No. 2.
Silica,	1.295	1.681
Peroxide of iron,	1.129	1.600
Lime,	20.692	26 872
Magnesia,	15.388	19.855
Sulphuric acid,	3.280	4.259
Phosphoric acid,	4.967	6.450
Chloride of potassium,	12.258	15.923
Potash,	17.987	23.360
Sand,	3.527	
Charcoal,	0.255	
Carbonic acid,	19.642	
	100.420	100.000

No. 7.—*Cow-Grass, Ordinary.*

Water,	81.76
Dry residue,	18.24
Ash in 100 parts of wet substance,	1.92
Nitrogen in ditto,	0.51
Ash in 100 parts of dry substance,	10·53
Nitrogen in ditto,	2.30

Analysis of Ash.

	No. 1.	No. 2.
Silica,	1.080	1.402
Peroxide of iron,	0.983	1.293
Lime,	23.586	30.251
Magnesia,	8.362	10.857
Sulphuric acid,	2.568	3.334
Phosphoric acid,	4.773	6.197
Chloride of sodium,	1.803	2.341
Chloride of potassium,	11.959	15.514
Potash,	21.981	28.541
Sand,	3.578	
Charcoal,	0.185	
Carbonic acid,	19.459	
	100.177	100.000

A general resemblance in the analytical results may be observed between these and the red clovers, in all the constituents. No. 7, however, from the larger proportion of nitrogen which it contains, must exceed them all in nutritive value. The other specimen—that which is considered a very fine variety—curiously enough is decidedly inferior, and stands on a level with the lower quality of red clover. I have not been informed as to the cause of its

reputed superiority, but it may be owing to its producing a more bulky crop, which may more than make up for the deficiency of quality.

The next two analyses are of samples of yellow clover, the one from English, the other from French seed.

No. 8.—Yellow Clover, raised from English seed.

Water,	77.38
Dry residue,	22.62
Ash in 100 parts of wet substance,	2.02
Nitrogen in do.,	0.56
Ash in 100 parts of dry substance,	8.95
Nitrogen,	2.47

Analysis of Ash.

	No. 1.	No. 2.
Silica,	1.64	2.07
Peroxide of iron,	1.30	1.64
Lime,	16.00	20.14
Magnesia,	7.78	9.80
Sulphuric acid,	4.00	5.03
Phosphoric acid,	4.48	5.64
Chloride of sodium,	7.57	9.53
Chloride of potassium,	10.86	13.67
Potash,	25.80	32.48
Sand,	6.34	
Charcoal,	0.48	
Carbonic acid,	13.23	
	99.48	100.00

No. 9.—Yellow Clover, raised from French seed.

Water,	78.60
Dry residue,	21.40
Ash in 100 parts of wet substance,	1.75
Nitrogen in do.,	0.47
Ash in 100 parts of dry substance,	8.18
Nitrogen in do.,	2.19

Analysis of Ash.

	No. 1.	No. 2.
Silica,	1.01	1.24
Peroxide of iron,	0 86	1.05
Lime,	18.61	22.80
Magnesia,	8.34	10.22
Sulphuric acid,	4.42	5.42
Phosphoric acid,	7.15	8.77
Chloride of sodium,	5.98	7.32
Chloride of potassium,	11.98	14.68
Potash,	23.26	28.50
Sand,	2.87	
Charcoal,	0.72	
Carbonic acid,	14.79	
	100.00	100.00

I mentioned in the outset that some persons considered yellow clover to be of little or no nutritive value, but these analyses show that this opinion must be ill-founded, for a comparison of the analyses leads us to the conclusion that it must be of at least equal value to red clover. In fact, the percentage of nitrogen in

both is greater than in red clover, and the amount of solid matters is fully as large as is found even in the best samples of that plant. In the constituents of the ash there is the same general resemblance to red clover which has been already remarked in the case of cow-grass, the only striking difference being in the smaller proportion of lime which the yellow clover contains.

From particular circumstances it was found impossible to make a complete analysis of the ash of the *Trifolium incarnatum*, but the determination of the amount of water, nitrogen, and ash, was made.

No. 10.—*Trifolium Incarnatum, from French seed.*

Water,	82.56
Dry residue,	17.44
Ash in 100 parts of wet substance,	1.88
Nitrogen in do.,	0.52
Ash in 100 parts of dry substance,	10.81
Nitrogen in do.,	2.97

It would appear from this that the crimson clover is a very valuable species, and surpasses any of the other specimens analysed, the amount of nitrogen being higher than any obtained from the other plants, and considerably above the average of the whole.

The last analysis was that of a single specimen of Lucerne, of which the results are given below.

No. 11.—*Lucerne.*

Water,	80.13
Dry residue,	19.87
Ash in 100 parts of wet substance,	2.49
Nitrogen in do.,	0.49
Ash in 100 parts of dry substance,	11.77
Nitrogen in do.,	2.48

Analysis of Ash.

	No. 1.	No. 2.
Silica,	2.34	3.18
Peroxide of iron,	1.98	2.68
Lime,	18.31	24.79
Magnesia,	4.64	6.28
Sulphuric acid,	4.27	5.79
Phosphoric acid,	5.75	7.80
Chloride of sodium,	1.70	2.30
Chloride of potassium,	10.35	14.02
Potash,	24.49	33.16
Sand,	10.62	
Charcoal,	0.35	
Carbonic acid,	15.02	
	99.83	100.00

It is unnecessary for me to dilate on the results which these analyses present, as the observations already made are sufficient to indicate the comparative values of the different substances. I shall take another opportunity of comparing them with the other sorts of cattle food, and shall then enter more fully on the subject of the principles upon which the nutritive value of these substances may be most satisfactorily estimated.

ANALYSES OF THE ASH OF THREE SPECIES OF SEA-WEEDS. BY MR JOHN YEATS.

The following analyses were made, during the past spring, on specimens of the weeds collected in the Firth of Forth. The analyses were conducted in the method usually employed for the analysis of ashes, and do not call for any remarks, except as to the mode of burning, and separation of iodine from the other constituents. The weeds, as soon as collected, were carefully examined, and all small shells and foreign matters picked off, after which they were washed with a small quantity of fresh water, and dried with a cloth, so as to remove as much as possible of the sea water by which they were moistened. They were then cut into small pieces, and dried by exposure to a temperature somewhat above 212°; and, when thoroughly dry, were incinerated in a large platinum basin. In doing this some difficulty was experienced, as, from the fusibility of the ash, it was very liable to melt and protect the carbonaceous matters from combustion, by forming a coating over them. By carefully keeping the heat very low, it was found possible to avoid this to some extent, and to get rid of the greater proportion of carbonaceous matters, but never to produce a white ash. Some benefit was gained by this necessity for employing a very low temperature; for, as the iodine salts, the accurate determination of which formed my special object, are very volatile at high temperatures, a certain proportion of them would almost inevitably be lost, if the plants were burned at such temperatures as may be safely employed in other instances. The determination of iodine was effected in the usual manner, by means of chloride of palladium. The *Fucus serratus* was taken from the low rocks beyond the quarry at Granton. The *Fucus nodosus* came from the coast near Burntisland, and was a remarkably large and fine specimen. The *Laminaria digitata* was taken from the Black Rocks, off Leith, at the very lowest spring tides. Great quantities of the weed grow in that locality, but are seldom accessible, owing to the depth of the water. The first column contains the actual results of analysis—the second, the results calculated without the sand, charcoal, and carbonic acid.

Laminaria Digitata.	1.	2.
Potash,	28.81	31.812
Chloride of potassium,	17.84	19.764
Iodide of potassium,	1.20	1.365
Chloride of sodium,	21.69	23.986
Lime,	5.01	5.351
Magnesia,	3.11	3.454
Peroxide of iron,	1.18	1.333
Sulphuric acid,	8.69	9.598
Phosphoric acid,	2.98	3.297
Silica,	0.03	0.050
Carbonic acid,	4.23	
Sand,	1.69	
Charcoal,	3.36	
	99.82	100.000

Fucus Serratus.	1.	2.
Potash,	28.11	30.870
Chloride of sodium,	5.60	6.148
Soda,	23.55	25.859
Lime,	7.22	7.927
Magnesia,	5.80	6.368
Peroxide of iron,	0.21	0.230
Sulphuric acid,	16.28	17.870
Phosphoric acid,	2.26	2.480
Silica,	2.04	2.246
Carbonic acid,	4.57	
Sand,	0.88	
Charcoal,	2.78	
	99.30	100.000

Fucus Nodosus.	1.	2.
Potash,	12.10	13.320
Chloride of potassium,	25.12	29.885
Chloride of sodium,	13.08	15.557
Lime,	6.43	7.647
Magnesia,	4.70	5.636
Peroxide of iron,	0.10	0.135
Sulphuric acid,	20.85	24.812
Phosphoric acid,	0.71	0.848
Silica,	0.97	1.160
Carbonic acid,	2.13	
Sand,	0.64	
Charcoal,	13.30	
	100.13	100.000

OBSERVATIONS ON THE POSSIBILITY OF IMPROVING THE QUALITY OF KELP. BY DR ANDERSON.

The foregoing analyses were intended to form part of an extended investigation which I proposed making, and which had for its object the determination of the economic value of sea-weeds, both as a manure and a source of kelp. For the purpose of arriving at satisfactory conclusions on these points, I intended to accumulate analyses, not merely of the ash, but also to determine the amount of nitrogen which the plants contain in the moist state, and such other facts as seemed necessary to define their manurial value. Want of opportunities for collecting sea-weeds at different localities and seasons, and occupation with other matters, of perhaps more general interest to the agricultural public, have hitherto prevented the active prosecution of the subject, and may delay its completion for some time. In the mean time, the following observations may not be unacceptable to those more immediately connected with the districts in which kelp is produced, as its improvement might be of some importance, and form a valuable means of giving increased employment to the poverty-stricken inhabitants of the Western Islands, as well as a source of improvement to their agriculture.

It is familiarly known to every one connected with the Highlands, that the price of kelp has of late years undergone a great change; and that, while during the war, £10, or even £20 per ton

were current prices, £2 or £3, and, in some instances even less, are all that can now be obtained for it; while that variety which is obtained from sea-weeds which are purposely cut, and is commercially known as cut-weed kelp, is almost entirely unsaleable. It is worth while to point out the causes of this remarkable depression. Thirty or forty years ago, kelp was one of the great sources of carbonate of soda—one of the most important raw materials of the chemical arts; and from it and barilla, which name is applied to the ash of the sea-weeds growing on the coast of Spain, nearly the whole of the soda employed in the arts was obtained. Barilla is a much more valuable source of carbonate of soda, and contains it in much larger quantity than kelp—the former yielding about 20 per cent of soda, the latter not more than from 2 to 4 per cent. Notwithstanding this difference, however, the high price of barilla always occasioned a considerable demand for kelp; but the circumstances connected with the war led to the rapid rise in its price and extension of its manufacture. Barilla, always expensive, and difficult to be obtained in quantity adequate to the demand for it, became entirely inaccessible to the manufacturer; and kelp, at that time the only other source of soda, underwent a proportionate rise in value; and the consequent increase in the price of soda was severely felt, and, for the time, almost annihilated some branches of manufacture. The difficulties which were felt here were equally experienced in France; but while, in this country, they were passively borne, without any attempt being made, either by themselves or the government, to relieve the manufacturers, a very different result followed in France; and Napoleon, impressed with the importance of cheap soda to the manufacturing industry of France, offered a reward of a million francs, or nearly £40,000, for a successful process for converting common salt into carbonate of soda. Several different processes were proposed, but one contrived by a chemist of the name of Leblanc, proved greatly superior to all the others, and fulfilled, in all respects, the proposed conditions. The process was soon adopted in France, and passed over into this country, and, with some modifications in detail, is still employed in all our manufactories; and though various other processes have since been patented, none of them have succeeded in displacing it. The consequence of the introduction of this process was an immediate fall in the price of soda; and as its practical working became better understood, and various improvements in the management of the details were introduced, a gradual and steady diminution in its cost has gone on ever since; and it is now sold at a price at which it could not be extracted from kelp, even if the manufacturer obtained that substance for nothing. In fact, kelp would at the present moment have been an utterly worthless article, had it not been for another chemical discovery, which, almost at the time that soda ceased to be extracted from it, con-

ferred a new value upon it. The discovery of iodine in the ashes of sea-weeds, and its value as a medicinal agent, has supported the kelp manufacture in a languid state for the last twenty years; but, from the small price which the iodine manufacturers are able to pay for it, as it is at present produced, there is no great encouragement to attempt increasing its production. It has, however, often struck me, that it might be possible to produce some improvement in this respect, which might be worthy the attention of some of our Highland proprietors.

The manufacture of kelp is carried on in the Islands of Scotland in the rudest and most primitive manner possible, and little or no attempt has been made to improve it. The process is conducted in just the same manner as it was when kelp was employed as a source of soda, and when that substance was attended to, and no thought taken of the other constituents. Now, however, things are completely changed—the soda is almost worthless; and though it is still extracted by the manufacturer, he does it merely because his doing so is a necessary step to obtaining the iodine, which is the substance from which he derives his profit. It is obvious that the manufacturer must now value a specimen of kelp for the iodine, and not for the soda, which it contains; and that, if the price of kelp is to be raised, it must be by producing it under the circumstances which are most favourable to obtaining a large percentage of iodine. Comparatively little attention has as yet been paid to this matter, and the old mode of manufacture is still adhered to—a method which, though favourable enough to the production of soda, is the very reverse as far as iodine is concerned, and requires to be entirely altered when it is sought to be obtained in larger quantity. In some places attempts have been made to modify the process, so as to obtain a kelp more suited to the iodine manufacturer, and with partial success; but the whole subject is still in its infancy, and deserves a more careful examination than it has yet received. In addition to iodine, a considerable quantity of chloride of potassium is now also extracted from kelp, and some part of its value is dependent upon that substance. But while it is possible, and indeed probable, that, by care and attention, the quantity of iodine may be considerably increased, it is improbable that any material difference can be produced in the quantity of the chloride of potassium.

The proportion of iodine which a specimen of kelp contains varies excessively, and depends partly on the weeds employed for making, and partly on the manner of burning. The analyses which are given in the previous notice indicate how much is dependent upon the former of these points; for while two specimens of kelp (made respectively from the *Fucus nodosus*, and *Laminaria digitata*) might be equally pure and carefully prepared, the one would be valuable, the other worthless. One of the

objects which I had intended to have examined more fully than it has yet been done, is the percentage of iodine in the ash of the different species of weeds; for though we have a considerable number of analyses at present, they are not as varied as might be desired, and none of them have been made with weeds collected in localities where the manufacture of kelp is actually pursued. It is uncertain, moreover, whether the determinations of iodine are all of them accurate; and, at all events, the differences are so great, as to render it desirable to repeat them with care. One thing appears, however, to be distinctly made out, and it is that the amount of iodine is largest in the different species of *Laminaria*, or what in Scotland is commonly called "tangle." Mr Yeats' analyses, while they indicate the entire absence of iodine in the *Fucus nodosus*, and the existence of traces only in *Fucus serratus*, show that the ash of *Laminaria digitata* contains 0.91 per cent of pure iodine, or upwards of twenty pounds in the ton. Other observers have found a much larger proportion; and Gödechens, who examined the same plant from the mouth of the Clyde, found its ash to contain 3.04 per cent of iodine, or upwards of sixty-six pounds in the ton; while from the *Laminaria saccharina* he obtained 3.9 per cent, or about eighty-seven pounds per ton. He obtained also a small quantity of iodine from *Fucus nodosus*, in which, as obtained from this coast, no traces could be distinguished, even by the most delicate re-agents. It is manifest, then, that the quality of a kelp must be to a great extent dependent on the plants which have been selected for its preparation; and that when, as has been too commonly the case, everything that the sea throws up is indiscriminately employed, a kelp must be obtained very inferior to that which might have been produced by a rough process of selection, in which all those weeds which yield little or no iodine are rejected, and those only employed which are rich in iodine. On the other hand, something depends also on the state in which the plants are collected, as is obvious from the different results obtained by Messrs Yeats and Gödechens—the latter obtaining more than three times as much iodine from the same plant as the former. The following series of analyses of another weed, *Fucus vesiculosus*, by different chemists, may serve to render this difference still more conspicuous:—

	Clyde.	Mersey.	North Sea.	Denmark.	Greenland.
Potash, ...	15.23	...	17.68	9.03	17.86
Soda, ...	11.16	15.10	5.78	7.78	21.43
Lime, ...	8.15	16.77	4.71	21.65	3.31
Magnesia, ...	7.16	15.19	6.89	10.96	7.44
Chloride of sodium, . . .	25.10	9.89	35.38	3.53	25.93
Iodide of sodium, ...	0.37	...	0.13	...	...
Phosphates of iron and lime,	2.99	...	5.44	9.67	10.09
Peroxide of iron, ...	0.33	4.42	...	...	...
Sulphuric acid, ...	28.15	30.94	23.71	26.34	13.94
Silica, ...	1.35	7 69	0.28	11.04	...
	100.00	100.00	100.00	100.00	100.00

Here two out of five contain iodine, and that in very small quantity, while in the others not the slightest trace of it is found. The conditions under which these differences occur have not been determined, but it appears probable that it may be dependent upon the degree of maturity of the plant. It is well known that, as far as land plants are concerned, their constitution is greatly different at different stages of their growth, and it is reasonable to suppose that the same may be the case with sea plants. No information is given by the analysts as to the period of the year at which their plants were obtained; but Mr Yeats collected his in early spring, and they were probably young plants, though they were as large as are usually found. However this may be, it appears desirable to make analyses at different seasons, for the purpose of establishing or refuting the idea of a difference in composition, and this I intended making part of my investigation. It is manifest that, whatever may be the changes which the weeds undergo at different seasons, the different species of *Laminaria* are always richest in iodine, and ought to be those selected for the manufacture of kelp. It may probably be urged that the separation of species would be attended with too great trouble and expense to make it practically available, and complete separation would certainly be so; but all that would be required would be the rejection of great masses of weeds containing only a small proportion of the species rich in iodine, and the selection of such as contained abundance of them. This might be effected without much labour, and the result would be the production of a better article.

Supposing a good supply of weeds to be selected, and properly dried, the next process is the burning, which requires to be effected with peculiar precautions, if the iodine is to be obtained in large quantity. The method commonly adopted is to burn it in hollow troughs, made of a few stones roughly put together, and from four to six feet long and broad, on which a fire is made, and the dry weeds are thrown on in suc-

cessive quantities until the supply is exhausted, or the trough becomes too full of the ash. In managing this process, the heat was urged as high as possible, so that the ash became white, as it thus obtained a higher price when brought to the market as a source of soda. So long as it was employed merely for the soda which it contained, this was a reasonable practice, and probably yielded a product richer in that substance than if it had been prepared at a lower temperature. But the circumstances most adapted for producing a good soda kelp are exactly those most injurious to an iodine kelp. The iodides which are present in the sea-weeds have a certain degree of volatility at a red heat; and when the temperature is kept high for a long time during the incineration, a great part of that which the weeds contain is volatilised and lost. The extent to which this takes place during the preparation of kelp is unknown, and is probably dependent on a variety of circumstances occurring during the combustion; but we know well that, in the laboratory, when iodide of potassium or sodium is heated in a crucible, it volatilises to an appreciable, and when a current of air is allowed to pass over it, to a very decided extent. The latter is most nearly analogous to the conditions under which sea-weeds are burnt at present; so that there can be little doubt that the loss from this cause must frequently be considerable. That it can be diminished to a great degree by a very simple modification of the present process is undoubted. In fact, all that is necessary is to carry on the combustion of the weeds at as low a temperature as possible, and in smaller quantities at a time, than was formerly practised; and, instead of endeavouring to obtain a pale coloured kelp, to consider this as rather an indication that the proper temperature has been exceeded, and that some loss of iodine has taken place.

It may be worth pointing out the great inferiority of the kelp now in the market, to what might be produced if proper attention were paid to the points to which I have referred. If kelp were made entirely from *Laminaria digitata*, it ought, according to the analysis of Mr Yeats, to yield 20 lb. of iodine per ton; while, if that of Gödechens be taken to represent the true composition of the plant, as grown in the Western Islands, it ought to yield between 60 and 70 lb. per ton. In actual practice, however, I believe that from 6 to 12 lb. of iodine is the quantity usually extracted from a ton of kelp; and it need scarcely be observed, that the manufacturer obtains almost the whole of the iodine the kelp contains, for the method of separation is well understood, and the profit or loss of the manufacturer depending upon very small differences, every attention is paid to obtaining, as nearly as possible, the whole of the iodine which the kelp contains.

It is on this remarkable difference between the results of analysis of the ash of sea-weeds and of the commercial kelp, that I found

the opinion that it may be possible to improve the quality of kelp to such an extent as to raise its price, not certainly to that which it once commanded, but to such an extent as to make it more deserving the attention of Highland proprietors than it has of late years appeared to be. It is at least obvious, that if the manufacturer can afford to pay from £2 to £3 for kelp yielding only from 6 to 12 lb. of iodine, he would be able to afford a much higher price if he could obtain it with 20, 30, or 40 lb. per ton. Both he and the kelp-maker would be benefited by such a change; for the extraction of iodine from a rich kelp is easier and less expensive than from a poor one; and, while he could thus afford to give the high price, the kelp-maker would be saved the labour of burning, and the cost of sending to market a large quantity of rubbish, which adds to the bulk, without increasing the value of the kelp.

It appears to me that a decided benefit would be derived from careful selection and careful burning of the kelp, and that if the conditions under which its quality is likely to be highest were clearly explained to the persons employed in making it, and a price paid to them for it proportionate to the amount of iodine which it contains, a stimulus would be given to the production of a superior article, and that, by exciting emulation among the workmen, much good might be done.

I am far, however, from supposing that these recommendations exhaust all that might be done for the production of kelp. It is probable that methods of manufacture greatly superior to those now in use, and more suited to the present condition of the chemical arts, might be introduced. But it is doubtful whether these could be successfully carried out by the population of the Islands, who are scarcely competent to operations which require skilled labour. Were it possible to do so, it is probable that part of the extraction of the iodine might be profitably carried on at the place where the kelp is made, and furnaces might be employed for its combustion, the heat of which would serve for the evaporation of some of the liquors. It can scarcely be expected, however, that, in the present state of the Western Islands, the necessary capital should be forthcoming for such operations, the more especially as they would at first be of the nature of experiments, which might possibly fail, although, if judiciously and prudently conducted, I cannot help thinking they might have beneficial results.

A process of a very different nature for extracting iodine from sea-weeds, was suggested some years since by Dr Kemp, which was founded on a number of experiments which he made in the Isle of Man. He found that, if a quantity of sea-weeds be placed in a vat or large cask, with a spigot-hole at the bottom, they soon undergo fermentation, and a liquid runs off, which at first is sea-water, but after a time is the juice of the plants, containing the whole, or at least a great part, of their iodine. To this fluid he

proposed to add a small quantity of chlorine and starch, when the iodine is thrown down in the form of an insoluble compound with the starch, which was to be collected and sent into the market as a source of iodine, while the refuse was to be employed as a manure. This process, though ingenious, is too purely chemical for the localities in which it would have to be carried out, and involves the use of very large vessels, which could not be constructed without some expense. I have given it as an illustration of a number of processes which are not sufficiently simple for the purpose, the social condition of the inhabitants of the localities in which kelp is produced requiring that any process entrusted to them shall be of the very simplest kind. But there can be little doubt that some improvements might be effected; and a full inquiry into the whole conditions of the kelp manufacture, both on the large scale, and chemically, might be of much value. Meanwhile a certain benefit would most assuredly be derived for carefully attending to those circumstances to which I have already referred.

ON THE NUTRITIVE VALUE OF THE DIFFERENT SUBSTANCES EMPLOYED AS FOOD FOR CATTLE.

In no department of agriculture has a greater and more rapid improvement taken place than in all that relates to the feeding of stock. Instead of being confined, for the most part, to suburban farms in the immediate neighbourhood of markets, the development of the turnip crop and the facilities of carriage for the cattle have extended it over all parts of the country, and have made it, if not an essential, at least a very important part of farming operations. Of late years its importance has been still further increased by the low price of grain, which has induced the farmer to rely for some part of his annual profit on the result of his feeding, in place of expecting it entirely, or almost entirely, from his white crops, as used formerly to be the case. The consequence of this has been, that much greater attention has been paid to the circumstances most likely to insure success, and important changes have been introduced in almost every point relating to the management of fattening stock. Some of these improvements have been suggested by experience, but no small part of them have had their origin in the applications of science, which has been brought to bear with peculiar advantage upon this department of agriculture. There is, indeed, scarcely any subject in which the benefits of science are more distinctly seen; and simply because there is no scientific subject, directly bearing upon agriculture, which has been so carefully studied, or is so well understood. The nutrition of the animal body is one of the most important and interesting departments of

physiology, and has engaged the attention of a large number of the most distinguished cultivators of the science; and, though extremely complex, and abounding in questions still far from being satisfactorily answered, it has been more thoroughly studied, and its principles better established, than most of the other portions of that science.

The effects of a knowledge of these principles, imperfect as they still are, is seen in all the more skilfully managed farms of the present day, which have their feeding-houses built, and the dieting of the cattle carried on, in a manner strictly concordant with the suggestions of science. It has also pointed out the principles on which the choice of foods is to be made, and their comparative value estimated, and some progress has even been made in the determination of their values. Our information on these points is, however, still limited; for though much has been done by Boussingault and others, they have confined their inquiries too exclusively to one element of the food—the nitrogen, which, though no doubt the most important, ought not to be the only one considered.

Ever since I became connected with the Highland and Agricultural Society, the investigation of the nutritive values of different sorts of food has engaged much of my attention; and one of the objects which I set before me was, by an extended and careful series of analyses, to fix them in a satisfactory manner. In doing so, I proposed to take up the different substances one by one; and, by making analyses of each, grown under all possible circumstances of climate, soil, and manure, to determine the limits within which its value might oscillate. The investigation of the turnip, which appeared in a late number of the *Transactions*, is an individual instance of what I intended to do for all the others. It is manifest, however, that the completion of such a plan, and the performance of an equally elaborate series of analyses of each substance, must occupy a considerable time, and defer the possibility of making a comparison to a period which could not be easily fixed, and during which a great part of the analyses must be comparatively useless. I therefore resolved, in place of concentrating my attention on one substance, to accumulate one or two analyses of each substance, which might be published in the mean time, and which might serve at least as approximative estimates, which might be afterwards made more exact, by increasing the number of analyses, and obtaining the mean of all.

In conducting these analyses, I determined to adhere to the plan adopted with the turnips, both for the sake of uniformity, and because experience had shown me that, in a more extended analysis, the minuteness of detail is not at all commensurate to the increased labour; and that by making thorough analyses of their ashes, which I at one time intended, I should only accumulate a

mass of details which, in the present state of science, could not be made available for practical purposes. It will be unnecessary for me to refer here to the method of analysis, which is exactly that detailed in my paper on the comparative values of turnips grown in different localities, and under different circumstances, where everything relating to it has been already mentioned. In the arrangement of the analyses I shall proceed upon the principle of taking those first which contain the largest quantities of nitrogen and oil.

LINSEED CAKE AND LINSEED.

I had just commenced a series of analyses of linseed cake, intended to be as extensive as possible, and to embrace the sorts obtained from different localities, when Mr Way's paper on the same subject appeared in the Transactions of the English Agricultural Society; and as it embraced almost all that I intended to examine, I at once abandoned the further prosecution of the subject, as the analyses it contained were more than sufficient to determine the average value of different samples. In one point only were my analyses more complete than Mr Way's—namely, in the determination of the proportions of earthy phosphates and phosphoric acid; and I shall therefore give here a few such analyses, both to show the general concordance with his results, and to give the amount of phosphates which I have invariably determined in all the other substances analysed. They are selected from those which have been at different times sent to the Laboratory, and the exact localities from which they came are, with one exception, unknown; but it is believed that they are mostly from the North German and Baltic ports, which principally supply this market.*

	1.	2.	3.	4.	5.	6. Wolgast.	Average.
Water,	12.00	11.72	13.52	15.55	10.21	11.65	12.44
Oil,	11.93	10.94	11.84	11.49	14.28	16.25	12.79
Nitrogen,	4.45	4.26	4.45	4.54	4.48	3.83	4.33
Ash,	5.36	6.86	5.23	...	6.69	6.54	6.13
The ash contained—							
Sand,	0.80	2.24	0.67	1.04	0.52	...	1.05
Phosphates,	2.38	2.78	2.37	2.68	3.23	2.95	2.73
Phosporic acid,	...	...	0.59	0.33	0.89	0.39	0.55

* Flensburg is one of the places from which large quantities come to Leith; and I believe several of the specimens were from that port.

(To be continued.)

ON THE ADULTERATION OF MANURES.*

By Professor ANDERSON, Chemist to the Highland and Agricultural Society.

As this, Gentlemen, is the first Monthly Meeting of the present session, I trust I may be permitted, before proceeding to the special matter I have to bring before you, to make a very few general observations. I cannot, on the present occasion, help looking back to the time at which I first addressed a monthly meeting of the Society, and contrasting the state of matters then with their condition now. I had then just entered on the duties of my office as Chemist to the Society; and I had done so with no ordinary anxiety, for I was well aware that at that time the application of chemistry to agriculture was peculiarly unpopular. The enthusiasm with which it had been received at its first introduction led to extravagant expectations, the disappointment of which had alienated all but a small number, who, having from the first taken a more moderate estimate of the advantages of science, saw that it had done good service to agriculture, and still retained an interest in its progress. I had not at that time paid more attention to the special applications of chemistry to agriculture than is naturally done by any chemist who aims at being properly acquainted with the different branches of his science; and I will frankly confess that I had great doubts about the prudence of connecting myself more closely with a department of science so unpopular, and so completely in discredit, as it then was. As I felt, however, that the prosecution of scientific agriculture had really been attended with beneficial effects, and had full confidence in the intelligence of the great body of farmers, and was convinced that, in the course of time, its true position and influence would come to be recognised by all, I resolved to embrace a position which very trifling circumstances would then have induced me to avoid. In fact, had I at that time held any other office, however small, I doubt much whether I should have been induced to engage in the prosecution of agricultural chemistry. As it was, I did engage in it, but I did so with great doubts as to what might be the consequences; being convinced that, if the unpopularity which then existed continued, I could do no more than share the discredit which attached to the science. For some time I trembled for the results; but what I heard and saw at these meetings soon gave me encouragement. I observed that though, when the present system was first adopted, the discussions were entirely restricted to the bare statement of practical facts, the speakers soon got into the way of discussing their causes; and, in doing so, they entered sometimes very fully into the scientific principles on which their practice depended.

* Dr Anderson delivered this address at the Monthly Meeting of the Society, held on the 17th of November.

I looked upon this as peculiarly encouraging, for it indicated that our best practical men must be becoming alive to the advantages of science. It appeared, in fact, from their observations, that they must have carefully studied the principles of their art; and remembering that many of these were not young men, but had been for many years engaged in farming, and knowing the amount of energy which it requires to enter upon a new study, after a man has fairly engaged in the active occupations of business, I drew the natural inference that it must have been a strong conviction of the advantage to be derived from it which had induced them to acquire this information. Since then, I have watched very anxiously the progress of agricultural chemistry, and I have seen the conviction of its utility gradually returning among those whose opinion is most valuable; and as I have been brought, in the course of my duties, in contact with a considerable number of the best farmers of different parts of the country, I have been enabled to see that this opinion is now becoming general. I do not mean to say that it is universal; on the contrary, there are still many who resolutely assure us that science has done, and will do no good, though, curiously enough, they will often refer to facts which chemistry only could have taught them. We now sometimes hear a man who tells us he knows nothing of science, and does not believe in its utility, talk fluently of phosphates and ammonia, and their comparative advantages and disadvantages—thus giving the best possible proof of how thoroughly science has become incorporated with practice. During the time I have been connected with the Society, I have considered it one of my duties to encourage the study of agricultural chemistry to the best of my power, while I have, at the same time, aimed at repressing the extravagant expectations formerly entertained, (and that to so great an extent that I have even been accused of going to the opposite extreme, and undervaluing its utility,) and introducing a more proper estimate of what it is to do for agriculture. I trust these exertions have not been without some effect; but I cannot help attributing much to our monthly meetings, and to the influence they have had in directing the practical farmers, all over the country, to that careful inquiry and observation which, in my opinion, cannot fail to convince them of the benefits to be derived from a knowledge of principles. With each successive year, the statements made at these meetings have become more minute and elaborate; and I doubt not that the present session will give us as valuable information as those which have preceded it.

I should have greatly preferred had the duty of occupying your attention, on this occasion, devolved on some other person; but as it has appeared that some advantage might be gained by discussing the important subject of the adulteration of manures, which has never yet been done at any of our meetings, I have undertaken to

bring before you such facts and observations as may appear to be practically useful. I do not intend, however, to confine myself entirely to those cases which come strictly under the head of adulteration—by which, of course, we understand only the mixture of foreign matters with the manures—but to take into consideration also those cases in which inferior but unadulterated manures are passed off as equal to the best, which I have good reason to know are very numerous, and are attended with equally serious consequences.

It is almost unnecessary to observe, that adulteration is principally practised on the high-priced manures, guano and superphosphates being those on which the most deliberate frauds are perpetrated; and though instances occur in which some of the rarer manures are sophisticated, they do not afford a sufficiently extensive field for the enterprising adulterator, while they generally admit of detection with greater ease. As the mode of adulteration, and substances employed, must necessarily vary with the manure, I shall discuss them separately, commencing with guano, both on account of its importance and the ingenuity which has been displayed in producing a spurious article, which it is absolutely impossible to distinguish from the genuine by the eye.

I believe the adulteration to be chiefly confined to Peruvian guano, the high price of which, and the conditions under which it is at present sold, being such as to give great encouragement to the practice. At first the adulterators employed the very simplest means, and contented themselves with the use of common sand, chalk, and gypsum; but these substances I believe now to be very rarely employed alone, because they all communicate to the mixture a greyish shade, which at once distinguishes it from genuine Peruvian. They are still found, however, to a certain extent, in some adulterated samples. The most common adulterations at the present time are two in number, one of which is with a particular yellowish loam, bearing a very close resemblance to guano itself, which is found on the banks of the Thames—I believe on Lord Mornington's property—and employed by the London adulterators on a very large scale. The other substance which is largely employed I believe to be coprolites, either finely ground, or after being treated with a certain quantity of acid; at least, I have examined a good many samples, the composition of which could only be explained on the supposition that this or some similar substance had been employed. I shall probably best make what I have to say intelligible by adducing the analyses of three samples of guano—No. 1, Illustrating the composition of genuine Peruvian; No. 2, That of the guano adulterated with sand; and No. 3, In which, I think, a complicated adulteration, either with partially dissolved coprolites, or with a mixture of ground coprolites and gypsum, must have been employed.

	No. 1.	No. 2.	No. 3.
Water,	12.98	15.32	12.06
Organic matter and ammoniacal salts,	53.32	22.51	34.14
Phosphates,	18.79	13.37	22.08
Sulphate of lime,	„	„	11.08
Alkaline salts,	14.87	11.01	12.81
Sand,	0.04	37.59	7.83
	100.00	100.00	100.00
Ammonia,	17.47	5.25	9.77

The last of these may be considered as representing a sort of adulterated guano, of which very large quantities are sold in Scotland. I have analysed samples from almost every port in the country, and have good reason to believe that many cargoes are sold which never come under my notice. I am unable to state the source of all these samples, but I know that some of them come from the Thames. And I have no reason to suppose that the adulteration is ever practised here; in fact, I suspect that in most of our towns such a process could not be carried on for any length of time without detection, all the manufacturing operations being too thoroughly under the eyes of the public. It is only in London, and some of the very large manufacturing towns, that it can be carried on with impunity; and even there I suspect that the guilty parties must be pretty well known, and very little inquiry would make any one acquainted with their names. For my own part, I have studiously avoided any such knowledge, as I do not think it desirable, in my position, to make inquiries on such a matter; but I know that some farmers of my acquaintance have traced cases of adulteration very clearly to particular individuals.

I have no doubt that a good many instances occur in which adulteration escapes detection, from the number of cases on which I have been consulted, where very trifling circumstances have awakened suspicion. A very curious illustration of this occurred to me in the beginning of the present year. Some articles were then published in *The Gardeners' Chronicle* on the subject of the adulteration of guano, which, after referring to the existence of certain manufactories into which large quantities of loam were carried, and out of which nothing but guano came, remarked that they should not be surprised if suspicions were entertained of the purity of the cargo of the "Pandora," which had sailed from the Thames for Berwick about a fortnight before. Meanwhile, the good folks at Berwick, who had quietly purchased the guano from the "Pandora" without a moment's thought, were struck with dismay, and sent off samples of the cargo to me for analysis, when it immediately appeared that it was really highly adulterated. At the very time, too, that this disclosure took place, another cargo of guano from the Thames was actually lying at Berwick, which, I suppose, was also adulterated. It was not, however, analysed: indeed, I believe suspicion on the part of the farmers was so

strong that no attempt was made to sell it there, and it was consequently shipped off to some more convenient quarter. Now, had it not been for the article to which I have alluded, the first of these cargoes would not have been suspected, and the second also would have been sold in Berwick.

It may be considered surprising that in this case the analysis had not been inquired for at first; but it is astonishing how often this is omitted, and how frequently farmers are contented to buy without any proper evidence of the purity of their purchase. What is still stranger, however, is that analyses are sometimes obtained by dealers in adulterated guano, which, I suspect, are made use of to sell it, although they show it to be of unfair quality. It may, at first sight, seem altogether contradictory that the very means of detection should be thus employed; but I believe that, even at the present day, many persons are unacquainted with what the composition of genuine samples of the different sorts of guano ought to be, and that the adulterators, presuming upon this, produce analyses which they would not venture to do if they knew that the purchasers were better informed. A case occurred to me some time since, in which I suspect that my analyses were thus employed. I received a sample of guano, which on analysis proved to contain 7 or 8 per cent of sand, and about 12 or 14 of gypsum, and which I accordingly reported to be an adulterated Peruvian. Soon after, I received from the same person two other samples, both of which were very similar to the first, and on them I gave a similar report. After a little while I got some more samples, all adulterated, and which I again reported to be similar to those before analysed. At first I was inclined to pity the unfortunate individual into whose hands so many adulterated guanos had fallen. By and by, however, I began to be a little suspicious; but the whole thing did not come out until I got another sample, which contained between 30 and 40 per cent of sand, and which I reported to be more disgracefully adulterated than any of the others. It then turned out that the individual who sent all these samples was an adulterator, and that he had bought 500 tons of the guano which he had last sent me, for the purpose of adulterating it; but he had got it from some knowing hand, who, thinking, I suppose, that there was no reason why he should not make the profit, had adulterated it before sending it off. I have little doubt that the analyses which had been obtained from me were employed in some way or other to sell the adulterated guano; and as any one at all acquainted with the composition of guano must have seen at once that they were analyses of adulterated samples, the only way in which it could have been done, must have been by producing them only to persons who were not likely to discover by inspection that they could not be genuine, and leading them to suppose that the mere fact of their having been analysed by a person of credit was a sufficient guarantee that all was right.

Did your time permit it, I could easily mention many instances in which ingenious devices have been fallen upon for passing off adulterated guano, but I hasten to refer to the methods by which the farmer may protect himself from such frauds. I need scarcely say that the only secure method is by analysis. It is necessary also to see that the analysis is by some chemist who is to be depended on,—and, fortunately, there are many chemists who are well skilled in the analysis of guano; but analyses are not unfrequently produced, which, to the chemist at least, immediately appear doubtful. The reason for this I believe to be, that the analyses of guanos are underpaid, and that many of them consequently fall into inferior hands. It is no uncommon thing, for instance, for a sample of guano to be brought to the laboratory along with an analysis setting forth that it contains 5 or 7 per cent of water, when a person of experience can see by simple inspection that it cannot contain less than 18 or 20, and to find no proper determination of the ammonia, but simply a statement of "salts of ammonia," which gives a very imperfect idea of the actual quantity of the ammonia itself. If the water be so low as 5 or 7 per cent, and no estimate of the amount of actual ammonia be given, another analysis ought always to be demanded. It will be necessary, also, frequently to ascertain that the analysis shown actually corresponds with the guano sold, cases having occurred in which a single analysis has been made to do duty for half-a-dozen cargoes. In order to avoid this risk, an analysis should be made on a sample taken by the purchaser from the quantity sent to him. Unfortunately, all this is attended both with trouble and expense; and it is most desirable that some simple means should be devised for enabling the farmer to determine the quality of his guano. I have devoted much consideration to this subject, and tried to contrive some simple method of analysis; but the conclusion to which I have come is, that it is impossible to contrive any plan which does not require a certain amount of chemical skill, which is not at present possessed by farmers. At the same time, I see no reason why it should not be possessed by the rising generation, for it presents no real difficulties; and he must be a very dull or a very careless person, who, after some months' study in a laboratory, is not capable of making with considerable accuracy all the ordinary analyses required for agricultural purposes. In the mean time, however, there are some characters which the practical man would do well to attend to when he is selecting a Peruvian guano. In the first place, its colour should be light. If it is dark brown, the chances are that it has been damaged by sea-water. It should not have a too powerfully ammoniacal odour. It should contain lumps, which, when broken, appear of a paler colour than the powdery part of the sample: these, in general, afford a very excellent method of distinguishing the genuine from the adulterated guano, the latter of which is usually a perfectly uniform powder; but even this must

not be too implicitly relied on, as it is alleged that the adulterators have managed to imitate it by sifting out the lumps, mixing the powder with the foreign matters, and then putting them in again. A small quantity rubbed between the finger and thumb should not feel gritty. Finally, a bushel of the guano should weigh about 50 lb., and if it greatly exceeds this, it is certainly adulterated. This last is an admirable method of detecting impurities; and it is founded on the fact that all the substances which can be employed to adulterate guano have a higher specific gravity than it has itself, and consequently add greatly to the weight of the bushel. It must be distinctly observed, however, that a certain amount of foreign matters might be added without producing a sufficient increase of weight to admit of a decided opinion; but still there do occur instances in which this is of a most valuable character. The observation of these characters will frequently enable you to detect a case of adulteration; but too much reliance must not be placed upon them, for they only give hints, and if no other precautions are taken, many adulterations must escape detection. I cannot too strongly impress upon you the importance of dealing only with men of character: no one who has a good standing will risk his reputation by selling doubtful guano, but for his own credit's sake will take care to assure himself that it is genuine. It may happen that the dealer himself is imposed upon; but if he uses ordinary precautions, this must rarely occur, and in such hands you must generally be safe.

While the adulteration of Peruvian guano is one of the most common things imaginable, I have been unable to satisfy myself of any instance in which the wilful adulteration of the other varieties has been practised. But we have here to guard against the purchase of inferior samples, for it is no uncommon thing with Chilian and Patagonian guanos to find sand, and occasionally carbonate of lime, present to a considerable, and sometimes even to a very large extent. Where this occurs, however, I believe that the guano has been brought home in the state in which it is sold, and that it is the cupidity of the collectors which has induced them to scrape the rocks, and bring off both sand and guano, which is the cause of the admixture. I have met with one case of a Chilian guano containing about 60 per cent of sand, in which I strongly suspected adulteration; but even with it I cannot be positive, as very shortly after we examined another sample containing about 40 per cent, and which was actually imported in that state, to the great disappointment of the owners. To the farmer, of course, it is a matter of very little moment whether the impurity has been wilfully added or not—his object is to be protected against it. But while Peruvian guano has some characters, the absence of which must excite his suspicion, there is none which can be in the least degree depended on with the other varieties. The appearance of different cargoes, and even of different parts of the same, is so variable, that nothing but

analysis can be depended upon for estimating their value. Not only is this the case, but great care is also necessary in selecting the proper samples for analysis; for while a sample of genuine Peruvian guano will be tolerably uniform throughout, and small quantities taken from different parts of it will give, on analysis, closely similar results, the very reverse of this is the case with all the others (excepting, indeed, Saldanha Bay)—so much so, that I have seen instances in which a cargo of Patagonian guano has shown differences to the extent of nearly 10 per cent in the amount of valuable constituents. The necessity, therefore, when such a guano is to be analysed, of selecting a proper sample, is sufficiently obvious; and I may mention the rules which are to be attended to in all cases, even with Peruvian. Take a large handful of the guano from as many different parts of the cargo as possible, (never from less than five or six,) and lay them all upon a large sheet of paper; then, stirring them all together with the hand as thoroughly as possible, take from the mixture a small quantity, as the fair sample of the whole, which should be preserved in a small box, or by folding it up in tinfoil, to prevent its becoming too dry. The analysis being made, the good or bad quality of the guano, when compared with that of genuine samples of the same variety, is easily judged of. It is often necessary to have some general idea of its value; and in this respect I think it important that there should be a more distinct conception of the relative values of different varieties of guano than appears at present to exist. It is no uncommon thing for us to receive a sample of Patagonian, Chilian, or Saldanha Bay guano, with a request that its value may be stated as compared with the best Peruvian. These are, however, two altogether different varieties of guano, between which no true comparison can be drawn. The value of Peruvian guano is mainly dependent upon the amount of ammonia which it contains, that of the others upon the phosphates; and the farmer will select the one or the other, according as he requires either of these elements. We can consequently compare different samples of Peruvian with each other, and also different samples of Saldanha Bay or Chilian; but Peruvian and Saldanha Bay are too unlike for proper comparison. The principle to proceed upon is, to remember that there are two great divisions of guano—the one of which may be called the ammoniacal guano, the other the phosphatic. The type of the first of these is Peruvian, in which, for the sum of £9, 10s., we purchase 22 per cent of phosphates and 17·5 of ammonia. The type of the other is Saldanha Bay, in which, for £6, 10s., we buy 56 per cent of phosphates and 1·5 of ammonia. When, therefore, we desire to estimate the value of any sample of guano, we must first observe to which division it belongs, and, comparing it with the standard of that sort, observe whether it exceeds or falls short of it in the amount of valuable matters, and estimate the gain or loss according to the standard price of that variety. I suspect, if this is carefully

done, it will turn out that a good many very inferior guanos are sold at a price as high, or higher, than good Saldanha Bay. A good deal of this is dependent on the tendency among dealers in inferior guano to depreciate analyses, which they feel to be disadvantageous to the articles in which they deal, and to attempt to establish their value in other ways. I remember, some years ago, analysing a sample of Chilian guano, containing 30 per cent of sand, and on which, as you may well imagine, I gave anything but a favourable report. Some months after, I met the dealer, and he accosted me very triumphantly, "Do you remember that guano you analysed for me, and which you reported to be so inferior?" I said I did; and he then informed me that he had sold a quantity to a farmer, whom he named, and that he had just got a letter from the purchaser informing him that it was the best guano he had ever had, and proved equal to the best Peruvian. It was in vain I endeavoured to point out to him that this was tantamount to saying that as good effects were produced by 2 cwt. of guano and 1 cwt. of sand as by 3 cwt. of guano alone. He could not see it at all, and I have no doubt he made a strong case out of this, and managed to sell many tons of the sandy guano.

I shall pass on to the consideration of dissolved bones or superphosphate, which is adulterated to as great or even a greater extent than guano. I may remind you, in the first place, that under these names were originally understood bones which had been treated with a certain quantity of sulphuric acid, which converts the insoluble phosphates more or less completely into a soluble state. At present, however, superphosphate is rarely if ever made exclusively from bones. A certain quantity of ground coprolites is almost invariably employed as a source of phosphates, and the necessary quantity of nitrogen obtained by the addition of some salt of ammonia. In some instances bones are entirely dispensed with, and small quantities of woollen rags and animal refuse of different sorts employed to supply the necessary amount of nitrogen; but all good manufacturers still use a considerable quantity of bones. The material which is thus produced is sold for about £7 per ton. Its composition, even when well prepared, is somewhat variable; but when obtained from a good manufacturer, it contains generally from 30 to 35 per cent of phosphates, of which from 10 to 15 are soluble in water, and nitrogenous matters capable of yielding from 2 to 4 per cent of ammonia. The remainder is water, sand, gypsum, sulphuric acid, and animal matter, in proportions which vary considerably according to the process of manufacture, and the proportions of bones, coprolites, and sulphuric acid employed. Now the value of superphosphate must be considered to depend upon the quantity of soluble phosphates which it contains; and to produce a perfect superphosphate, all its phosphates *should* be soluble. In practice, however, this cannot be effected, and a certain proportion is always found in an unchanged condition. It

will, of course, readily be understood that the phosphates which remain insoluble, and the ammoniacal compounds, must also contribute, to a certain extent, to the value of the manure; but as these can be bought in other substances at a cheaper rate, they form only a small part of the value of a superphosphate, in estimating the quality of which we must look almost exclusively to the soluble phosphates, of which we must not be content with less than 10 per cent. Now it so happens, that, according to my experience, very little of that which is sold in Scotland is equal to this; and I regret to say that a large proportion of it does not contain any soluble phosphates at all. Were it necessary to do so, I could illustrate this statement with numerous analyses, some showing the presence of 1, 2, or 3 per cent of soluble phosphates, and others containing carbonate of lime, the presence of which is incompatible with their existence—but all sold at about £7 per ton, although their value is much less. These samples emanate from a class of inferior manufacturers, who are perfectly aware that the article they produce is not a true superphosphate. The method of preparation they employ is exactly similar to that of the good manufacturers, except that they avoid bones, which are far too expensive an article for them, and employ only coprolites, and diminish greatly the quantity of sulphuric acid. But coprolites are obtained of various qualities, some containing a very large percentage of phosphate of lime, others much carbonate of lime. As the latter are cheaper, they are also employed by these manufacturers; and the consequence is, that when a small quantity of sulphuric acid is added, it does no more than decompose the carbonate of lime present, expelling its carbonic acid, and never attacks or dissolves the phosphate of lime. In other instances the method of manufacture is different: a large quantity of sulphuric acid is poured upon a small quantity of coprolites, and is allowed to remain in contact with them for some time. The resulting mass is true superphosphate, still very moist, and, in the hands of a good manufacturer, would be dried up on a kiln of a particular construction. The fraudulent manufacturer, however, avoids this expense, and adds a large quantity of ground coprolites, for the purpose of drying up and giving bulk to the mixture. The addition of this quantity of coprolites undoes what he had used his acid to effect, for the carbonate of lime which they contain reacts upon the soluble phosphates in the quantity which has been treated with sulphuric acid, and brings them back into the insoluble state. Whatever be the exact method of manufacture resorted to, however, the results are the same, and the product contains little or no phosphates in that condition in which, according to the name given to the manure, they ought to be. The detection of this spurious superphosphate is easily effected by any one who is at all acquainted with chemical manipulation. All that is necessary is to put a small quantity of the substance into a

glass or earthen vessel, pour upon it two or three times its bulk of boiling water, and, after it has stood for some time in a warm place, to filter the fluid through paper or fine calico, so as to obtain a perfectly clear fluid. On the addition of a small quantity of spirit of hartshorn, (ammonia,) the fluid becomes filled with a thick white precipitate, if it contains soluble phosphates, and remains quite clear if it does not. Of course, this will not distinguish between different qualities of the genuine article, but at once shows the absence of soluble phosphates. An instance in which a quantity of so-called superphosphate had been purchased by some farmers, and applied to the land on a pretty extensive scale, occurred to me some time since; and as no effects were produced, a sample was sent to me, and proved to contain no soluble matter. Yet this manure was averred by the manufacturers to be equal to the best guano; and they produced a large number of certificates from farmers who had obtained most wonderful effects from its use. I have been the means of detecting several such cases, and have had some disagreeables with the manufacturers in consequence, and some rather amusing scenes. Some time since I reported that a sample from a particular manufactory contained no soluble phosphates; and I shortly after received a letter, enclosing one from the manager of the work in question to the partners. This letter commenced by stating that the writer, from the method of manufacture employed, knew that the manures did contain soluble phosphates, and went on to say that Dr Anderson might be a very good chemist, but that it was obvious he did not know how to analyse a sample of superphosphate. I was inclined, as you may imagine, to consider this somewhat personal, but was relieved, on reading further, to find the more sweeping assertion, that no chemist had ever yet made a proper analysis of a superphosphate; and the reason was stated to be, because they commenced their analysis by treating the manure with water, which caused the soluble phosphates to become insoluble, and gave a totally erroneous result. I was requested to reply by explaining my results, and in doing so I suggested that these must be very remarkable soluble phosphates which were rendered insoluble by treatment with water, and contented myself with putting a question in return, and asking how it happened that, on analysing the manures of certain manufacturers, chemists found that they could, without any difficulty, extract 10 or 15 per cent of superphosphates, and by recommending that they should endeavour to make their manures in such a manner that the soluble phosphates should not be rendered insoluble by water, which was exactly what the farmers did not want. But I have not learned that my advice was adopted; and it is probable that the manufacture is carried on on the old plan. Some idea of the quantity of such substances produced may be formed, when I state that the sales of one manufactory, which,

however, produces some substances not manures, (though on a small scale,) I have been informed, amount to above £40,000 a-year. Where the manufacture is carried on on so large a scale, numerous devices are fallen upon for promoting the sale of the products—such, for instance, as offering quantities of the manures *gratis* to farmers' clubs for experiment, on condition that a report is given of the results. I know one case in which this was lately done by a firm which produces a superphosphate containing no soluble phosphates; but the sample sent to the club was superior, and contained about 5 per cent of soluble matters.

The adulteration of other manures need not occupy us long. Indeed, few of them are of sufficient importance to be much adulterated, and many of them could not be mixed with other substances without detection immediately taking place. It is curious, however, what primitive adulterations are sometimes perpetrated. I have seen bone-dust adulterated with oyster shells, of which it was possible to pick out large lumps, and with fragments of limestone and other stones. I have also seen a quantity of common salt, sulphate of soda, and other substances, mixed with it; but such adulterations, of course, are very rare. Nitrate of soda is sometimes adulterated with common salt, and sulphate of ammonia with salt or with sulphate of soda; but I have never met with any of these sophistications, and I believe them to be comparatively rare.

In short, I consider that guano and superphosphate are the manures on which the adulterator expends his chief ingenuity. But the farmer has also to guard against a class of manufactured manures which profess to be equal to the best guano. It is difficult to give any general statements regarding such substances, as they vary greatly in composition. So far, however, as I have observed, dissolved bones or coprolites form the basis of most of them, and gypsum, kelp, nitrate of soda, guano, and sulphate of soda, are frequently added. Their principal peculiarity is, that they are generally sold at a somewhat higher price than dissolved bones, while their value is usually lower—a considerable part of their bulk being made up by means of those substances, such as kelp and sulphate of soda, which are of very low value, both commercially and agriculturally. I should only give you a mass of dry detail did I attempt to enter into a description of these substances; and it is not necessary for me to do so, as I believe the farmers of Scotland are now very cautious about purchasing them, and but small quantities are disposed of.

It now remains for us to consider what steps are to be taken to prevent adulteration; but after having occupied so much of the time of the meeting, I must dismiss this part of the subject with a very few words. I may distinctly state, that I do not think it possible to prevent it altogether; but I am convinced that, with care, it might be brought within comparatively narrow

limits. The great protection, in my opinion, is to deal always with persons of credit; and it fortunately happens that there is no want, both of dealers and of manufacturers, who do their best to supply the farmer with genuine articles. These individuals are put at a great disadvantage by the fraudulent dealer, who, for the same price, produces an article which is in reality of comparatively little value, but which he recommends in the most unscrupulous manner, and probably manages to sell more successfully than the fair dealer. If we add to the precaution of carefully inquiring into the character of the merchant, and the sources from which he derives his supply, the security of analysis, I am convinced that there would be but little adulteration; but so long as persons continue unhesitatingly to buy anything that is offered them as manure, I do not see how we are to do any good. I know well that the fair dealers are most anxious to second the attempts of the farmers to protect themselves against fraud, and it is surely worth every effort on the part of those who are expending large sums in the purchase of manures, to do so.

REPORT ON THE BEST MODES OF HOUSING, AND ON SOILING AND PASTURING CATTLE.

By Mr Andrew Templeton, Clandeboye, Holywood, Ireland.

[Premium—The Gold Medal.]

On the 24th April 1851 I purchased eighteen pure-bred Galloway cattle, three years old, which had been bred and kept by the same farmer, in Ayrshire, on high mountain-land, from the time they were one year old, and had not been housed, nor got any artificial food, with the exception of a little coarse hay in winter. When they arrived here, I put them into a bare pasture-field, and gave them turnips and straw, which, in the course of a few days, they eat readily. They were continued on these till the 17th May, when they were brought into the straw-yard, and fed upon Italian grass, and where they learned to eat linseed-cake and grain.

Having resolved to test the comparative merits of the hammel, or box with small yard, and the stall; and of soiling and of pasturing, in fattening cattle; and whether a small quantity of linseed-cake consumed by them would be profitable or not, I had, on the 5th of June, the cattle divided and weighed into six as equal lots of three each as I could select them, two bullocks and one heifer in each lot, (the heifers being spayed,) and all apparently in the same state of health and growth, having been previously kept and fed alike. The lots were housed, and treated as follows:—

Lot 1, in hammels or boxes with a small yard, with 3 lb. of linseed-cake each per day.

Lot 2 in ditto, with no cake allowed them.

Lot 3 in stalls, with 3 lb. linseed-cake each per day.

Lot 4 in ditto, with no cake allowed them.

Lot 5 on pasture, with 3 lb. linseed-cake each per day.

Lot 6 on ditto, with no cake allowed them.

Having a plentiful supply of grass during the summer, and having everything done under my own eye, the utmost care was taken that the quantities of food given should be alike, and at regular intervals, and the weights exactly ascertained at the respective dates specified.

The stalls were 7 feet in width, and to contain two cattle each. The feeding-trough of each stall was supplied with food from a passage in front, of 4 feet in breadth. Behind each stall was a gutter to receive the dung and urine from the animals.

The hammels or boxes were three in number, to contain three cattle each. They were about 12 feet square, and roofed over, having a feeding-trough along the inner back wall. The open court-yards were also about 12 feet square each, and each had a feeding-trough of 7 feet in length in it, with a gate of entrance in front.

TABLE I.—Showing the Weight of Eighteen Galloway Cattle, when put up to feed, 5th June 1851.

	cwt.	qrs.	lb.	
No. 1.	10	0	0	
2.	8	1	14	
3.	7	2	14	
	26	0	0	Weight of Lot 1, which was put into hammels, and each animal had 3 lb. linseed-cake per day.
No. 1.	9	2	0	
2.	8	0	0	
3.	8	0	0	
	25	2	0	Weight of Lot 2, which was put into hammels, with no cake allowed them.
No. 1.	10	0	0	
2.	9	0	0	
3.	7	3	0	
	26	3	0	Weight of Lot 3, which was put into stalls, and each animal had 3 lb. linseed-cake per day.
No. 1.	9	0	0	
2.	8	0	0	
3.	7	2	0	
	24	2	0	Weight of Lot 4, which was put into stalls, with no cake allowed them.
No. 1.	8	2	0	
2.	8	1	21	
3.	7	2	7	
	24	2	0	Weight of Lot 5, which was put on pasture, and each animal had 3 lb. linseed-cake per day.
No. 1.	9	0	7	
2.	8	0	14	
3.	6	3	7	
	24	0	0	Weight of Lot 6, which was put on pasture, with no cake allowed them.

TABLE II.—5th July 1851.

	cwt.	qrs.	lb.	
No. 1.	10	3	0	Lot 1 increased 2 cwt. in the course of the month in the hammels, each animal being fed with 3 lb. of cake per day, making the quantity 270 lb., and the cost, at three farthings the lb., 16s. 10½d., along with vetches and Italian ryegrass.
2.	9	0	0	
3.	8	1	0	
	28	0	0	
No. 1.	10	0	7	Lot 2 increased 1 cwt. 3 qrs. 21 lb. during the month in the hammels, having been fed on vetches and Italian ryegrass, with no cake. These two lots in the *hammels* increased in weight, during the course of the month, 3 cwt. 3 qrs. 21 lb.
2.	8	3	14	
3.	8	1	0	
	27	1	21	
No. 1.	10	3	0	Lot 3 increased 1 cwt. 2 qrs. in the course of the month in stalls, with 3 lb. of cake to each animal per day, making the quantity 270 lb., and the cost, at three farthings the lb., 16s. 10½d. They had vetches and Italian ryegrass besides.
2.	9	0	14	
3.	8	1	14	
	28	1	0	
No. 1.	9	1	0	Lot 4 increased 1 cwt. 2 qrs. in the month in the stalls, on vetches and Italian ryegrass, without cake. The two lots in the *stalls* increased in weight, in the course of the month, 3 cwt.
2.	8	2	0	
3.	8	1	0	
	26	0	0	
No. 1.	9	1	0	Lot 5 increased 2 cwt. in the course of the month, on pasture with 3 lb. of cake to each animal per day, making the quantity 270 lb. which, at three farthings the lb., gives a cost of 16s. 10½d.
2.	9	1	0	
3.	8	0	0	
	26	2	0	
No. 1.	9	2	0	Lot 6 increased only 2 qrs. in the month, on pasture, without cake. The two lots on *pasture* increased, in the course of the month, 2 cwt. 2 qrs.
2.	8	2	0	
3.	6	2	0	
	24	2	0	

The cattle in the first four lots of this table received three feeds of Italian ryegrass and one feed of winter tares every day, each lot receiving the same quantities. The lots on pasture were in different fields, but the grass was equally good in quantity and quality.

It seems unnecessary to continue such details for each month to the 5th of February 1852:* suffice it to state the particular circumstances observable in each month. In July, the elements of feeding were precisely the same as in June. The grass and vetches were not so good as in June, and the cattle in the hammels and stalls, in consequence, did not improve so much as in that month. Those on pasture had good grass.

In August, the cattle in the hammels and stalls were fed on Italian ryegrass and clover, instead of winter vetches. The Italian

* It is but justice to Mr Templeton to state, that he furnished tabular statements containing as minute particulars as the above for every month, to the 5th of February 1852.—EDITOR.

ryegrass was given in three feeds a-day, and the clover one feed, both being very succulent and good. The cattle in the hammels and stalls, as well as on the pasture, had 279 lb. of cake to each lot, which enhanced the cost to 17s. 5¼d. The pastures were good, and the cattle made more improvement than in any other of the months.

In September, the cattle in the hammels and stalls were fed on Italian ryegrass; but neither it nor the pasture was so good as in August, and the cattle, in consequence, did not make so much improvement. The quantity of cake given to each lot was 270 lb., which reduced the cost again to 16s. 10½d.

In October, the cattle in the hammels and stalls were fed with two feeds of grass and one of yellow turnips and hay every day. Both the grass and pasture being deficient, the cattle made no improvement, except those in the hammels, of which one lot gained 2 cwt. 2 qrs. 21 lb., and the other 1 qr., in the course of the month. The quantity of cake given to each lot was 279 lb., and the cost was again enhanced to 17s. 5¼d. On the 5th of November, the cattle on pasture in Lot 5 were put beside those in the hammels in Lots 1 and 2, while those of Lot 6 were put into stalls beside Lots 3 and 4. The cattle now received the same kind and quantity of turnips.

In November, the cattle in both hammels and stalls had each 84 lb. of yellow turnips, and 14 lb. of hay, at three feeds. No. 2 of Lot 6, in the stalls, lost 28 lb. in the course of this month, and made no improvement during the experiment, which caused a great drawback in this lot. No reason could be assigned for this state of the animal, as it seemed as healthy as its companions. Each lot had 270 lb. of cake, at a cost of 16s. 10½d.

In December, all the cattle received 84 lb. of Swedish turnips, and 14 lb. of hay, at three feeds. The improvement of the cattle on the Swedish turnip was very strikingly exemplified over that on the yellow turnip. The quantity of cake consumed by each lot was 279 lb., at a cost of 17s. 5¼d.

In January 1852, all the cattle were fed in the same manner as in the preceding month, both as regards turnip, hay, and cake. The improvement in the condition of the cattle in the course of the month was very manifest, and would have been as great as in August, had it not been for the stationary state of No. 2 in Lot 6, as already referred to.

The following Table exhibits the particulars of each lot of cattle, and of each animal, from the 5th of June 1851, to the 5th of February 1852, giving the increase of each animal for the eight months, and the increase of each lot for the same time, together with the qualities and cost of the cake consumed, as also the difference of increase in the different modes of treatment, and these between the three lots that had cake, and those which had none.

TABLE III.

Lots.	Nos.	How fed.	Weight on 5th June.	Weight on 5th July.	Weight on 5th Aug.	Weight on 5th Sept.	Weight on 6th Oct.	Weight on 5th Nov.	Weight on 5th Dec.	Weight on 5th Jan.	Weight on 5th Feb.	Increase of each animal for 8 months	Increase of each lot.	Quantity of cake used by each lot.	Price of cake used by each lot.
			cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb	L s d
Lot 1	1	Fed in hammels, and had 9 lb. cake per day.	10 0 0	10 3 0	10 3 0	11 2 0	11 3 0	12 0 14	12 3 7	13 2 0	14 2 0	4 2 0			
	2		8 1 14	9 0 0	9 0 0	10 0 0	10 0 0	11 3 7	11 3 14	11 3 14	12 0 0	3 2 14			
	3		7 2 14	8 1 0	8 2 0	9 1 0	9 1 0	9 2 0	9 2 7	10 0 0	10 3 0	3 0 14	11 1 0	19 2 21	6 17 9¾
Lot 2	1	Fed in hammels, without cake.	9 2 0	10 1 7	10 3 0	11 2 0	11 3 0	11 2 0	12 0 14	12 1 0	13 2 0	4 0 0			
	2		8 0 0	8 3 14	8 3 14	9 2 7	9 3 0	9 3 0	9 3 0	10 1 14	11 0 0	3 0 0			
	3		8 0 0	8 1 0	8 3 0	9 2 0	9 1 0	9 3 0	9 3 0	10 0 0	10 2 0	2 2 0	9 2 0		
Lot 3	1	Fed in stalls, and had 9 lb. cake per day.	10 0 0	10 3 0	10 3 0	11 2 0	12 0 0	11 3 14	12 1 0	12 2 0	13 0 0	3 0 0			
	2		9 0 0	9 0 14	9 2 7	10 0 0	10 1 0	10 2 0	10 2 0	11 1 0	12 0 0	3 0 0			
	3		7 3 0	8 1 14	8 1 14	9 2 0	9 3 0	9 2 0	9 3 14	10 2 14	11 0 0	3 1 0	9 1 0	19 2 21	6 17 9¾
Lot 4	1	Fed in stalls, without cake.	9 0 0	9 1 0	9 2 0	9 3 0	10 0 0	10 0 0	10 0 0	10 2 0	11 1 0	2 1 0			
	2		8 0 0	8 2 0	8 2 0	9 0 0	9 1 0	9 0 0	9 0 14	9 3 0	10 2 0	2 2 0			
	3		7 2 0	8 1 0	8 1 0	8 2 0	8 2 0	8 2 14	8 2 14	9 1 0	10 1 0	2 3 0	7 2 0		
Lot 5	1	Fed on pasture, and in hammels, and had 9 lb. cake per day.	8 2 0	9 1 0	10 1 0	10 2 0	10 3 0	10 3 0	11 0 0	11 1 21	12 0 0	3 2 0			
	2		8 1 21	9 1 0	9 3 0	10 2 0	10 2 0	10 2 0	10 2 7	10 3 7	12 0 0	3 2 7			
	3		7 2 7	8 0 0	8 1 0	9 2 0	9 3 0	9 3 0	10 0 0	10 2 0	11 0 0	3 1 21	10 2 0	19 2 21	6 17 9¾
Lot 6	1	Fed on pasture, and in stalls, without cake.	9 0 7	9 2 0	10 0 0	10 3 0	11 0 0	11 1 0	11 1 0	10 2 0	11 2 0	2 1 21			
	2		8 0 14	8 2 0	8 3 0	9 1 0	9 1 0	9 0 0	9 0 0	9 0 0	9 0 0	0 3 14			
	3		6 3 7	6 2 0	7 1 0	8 0 0	8 0 0	8 0 14	8 0 14	9 1 0	9 1 0	2 1 21	5 3 0	59 0 7	20 13 5¼

ABSTRACT.

	cwt qr lb
Lots 1 and 2, in the hammels, gained in eight months, ...	20 3 0
Lots 3 and 4, in the stalls, gained in eight months, ...	16 3 0
Lots 5 and 6, on pasture, and afterwards in hammels and stalls, gained in eight months, .	16 1 0
The nine cattle that had cake, gained in eight months, ...	31 0 0
The nine that had no cake, gained in eight months, ...	22 3 0
Making in favour of Cake, .	8 1 0

TABLE IV.

Lots.	Nos.	Live weight of each animal, 5th June.	Live weight of each animal, 5th Nov.	Live weight of each animal, 5th Feb	Date when the cattle were slaughtered.	Live weight of each animal when slaughtered.	Weight of fore-quarters of Beef.	Weight of hind quarters of Beef	Weight of the Beef of each animal.	Weight of Beef in the different lots.	Weight of Fat of each animal.	Weight of Fat of each lot.	Weight of Hide of each animal.	Weight of Hides of each lot.	Butcher's remarks on the quality of the Beef.
		cwt qr lb	cwt qr lb	cwt qr lb		cwt qr lb	lb	lb	cwt qr lb	cwt qr lb	lb	lb	lb	lb	
Lot 1.	1	10 0 0	12 0 14	14 2 0	March 1, 1852.	14 1 0	237 242	205 213	8 0 1		105		105		Prime quality of Beef.
..	2	8 1 14	11 3 7	12 0 0	.. ..	12 2 0	199 199	177 173	6 2 20		82		93		Do. do.
..	3	7 2 14	9 2 0	10 3 0	.. ..	11 0 0	169 163	158 152	5 2 26	20 1 10	102	289	67	265	Do. do.
Lot 2.	1	9 2 0	11 2 0	13 2 0	March 15, 1852.	13 3 0	209 214	188 185	7 0 12		75		96		Good Beef, but rather light coloured.
..	2	8 0 0	9 3 0	11 0 0	.. ..	10 3 0	177 173	146 144	5 2 24		57		76		Do. do.
..	3	8 0 0	9 3 0	10 2 0	.. ..	11 0 0	155 153	156 152	5 2 0	18 1 8	115	247	68	240	Do. do.
Lot 3.	1	10 0 0	11 3 14	13 0 0	April 5, 1852.	14 2 0	236 230	212 210	7 3 20		118		89		Prime quality of Beef.
..	2	9 0 0	10 2 0	12 0 0	.. ..	13 0 0	196 188	177 173	6 2 6		102		78		Do. do.
..	3	7 3 0	9 2 0	11 0 0	.. ..	11 2 0	184 180	171 166	6 1 1	20 2 27	95	315	71	238	Do. do.
Lot 4.	1	9 0 0	10 0 0	11 1 0	April 12, 1852.	12 0 0	184 180	166 167	6 0 25		84		67		Prime quality of Beef.
..	2	8 0 0	9 0 0	10 2 0	.. ..	11 0 21	165 171	151 147	5 2 18		117		67		Do. do.
..	3	7 2 0	8 2 14	10 1 0	.. ..	11 1 0	154 153	153 146	5 1 18	17 1 5	118	319	77	211	Do. do.
Lot 5.	1	8 2 0	10 3 0	12 0 0	March 22, 1852.	12 0 0	195 196	178 169	6 2 10		103		73		Good Beef but rather high coloured.
..	2	8 1 21	10 2 0	12 0 0	.. ..	12 0 0	190 185	182 173	6 2 2		93		84		Do. do.
..	3	7 2 7	9 3 0	11 0 0	.. ..	11 2 0	160 157	162 165	5 3 0	18 3 12	131	327	57	214	Do. do.
Lot 6.	1	9 0 7	11 1 0	11 2 0	March 30, 1852.	11 2 0	188 191	174 171	6 1 24		101		83		Prime quality of Beef.
..	2	8 0 14	9 0 0	9 0 0	.. ..	9 3 0	148 150	148 140	5 0 26		88		70		Do. do.
..	3	6 3 7	8 0 14	9 1 0	.. ..	9 3 0	146 144	141 136	5 0 7	16 3 1	73	262	61	214	Do. do.

Table IV. gives details embracing the results of the previous experiments, in the form of the beef and fat yielded by each animal on being slaughtered. The cattle were sold to Mr Thomas Gaffikin, Flesher, Corn Market, Belfast, in February, one lot to be taken away every week, commencing on the 1st of March 1852, on the understanding that an accurate account of the beef of each quarter, and of the fat and hide of each animal, should be kept and reported. Mr Gaffikin having a large supply of cattle from Scotland in the second week of March, it was inconvenient for him to uplift any of the lots under experiment in that week, but ever after that period he uplifted them according to agreement.

It will be observed from the Table that Lot 1 was first slaughtered; Lot 2, second; Lot 5, third; Lot 6, fourth; Lot 3, fifth; and Lot 4, sixth;—making a difference of six weeks and one day between Lot 1 and Lot 4, which would have made a difference on the average increase of Lot 1 of fully two cwt.

In each of the lots the heifers were No. 3; and it will be observed from the Table, that, although they were lighter than the bullocks, they produced more fat. Also, that Lot 4, which had no cake, had more fat than Lot 3, which had cake, but it had not either so much beef or hide as Lot 3. Again, Lot 5, which had cake, had more fat than any of the lots, although considerably less beef than either Lot 1 or Lot 3. Lots 1 and 2 had heavier hides than any of the others.

At the commencement of the experiment I selected nine one-year-old cattle, a cross from the Ayrshire cow and short-horned bull, which were bred on this farm, and divided them into three lots, which were put up to feed as follows:—

Lot 1 in hammels.

Lot 2 in stalls.

Lot 3 on pasture.

They had a good supply of grass, and 3 lb. linseed-cake each per day. They were weighed monthly, from the 5th June 1851 to the 5th February 1852, when they were sold. But their dead weights could not be ascertained, as part of them went to the Liverpool market. Lot 3 was first on pasture, and then put into hammels on 5th November. Table V. (on following page) shows the live weight from June to February.

In concluding my remarks upon the different modes of treating cattle which have been adopted here, I may observe that the cattle in all cases made the greatest improvement in the hammels, and that the lots which had 3 lb. linseed-cake each per day, made a fair return for the value of cake consumed. The cost of erecting hammels and byres for stall-feeding will be nearly the same, unless at farm-steadings, where there are walls against which can be placed sheds, as has been done here, and which makes the

TABLE V.

Lots.	Nos.	How Fed.	Weight on 5th June.	Weight on 5th July.	Weight on 5th August.	Weight on 5th Sept.	Weight on 6th Oct.	Weight on 5th Nov.	Weight on 5th Dec.	Weight on 5th Jan.	Weight on 5th Feb.	Increase of each Animal.	Increase of each Lot.
			cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb	cwt qr lb
1.	1	Fed in hammels, with 9 lb. cake per day.	8 3 0	9 1 7	9 3 0	10 1 14	10 2 14	10 3 0	11 1 0	11 3 0	12 1 0	3 2 0	...
	2		7 3 0	8 2 0	9 2 0	10 0 0	10 1 14	10 2 0	11 0 0	11 1 7	12 0 0	4 1 0	...
	3		7 1 0	7 3 7	8 2 7	9 3 0	10 1 0	10 2 0	10 3 0	10 0 21	11 1 14	4 0 14	11 3 14
2.	1	Fed in stalls, with 9 lb. cake per day.	8 3 7	9 2 0	9 2 0	10 0 7	10 2 0	11 0 0	11 1 0	11 1 0	11 1 0	2 1 21	...
	2		7 1 14	7 2 14	8 0 0	9 0 0	9 3 0	9 2 0	9 3 0	10 0 0	10 2 0	3 0 14	...
	3		6 2 0	7 0 0	7 1 0	8 1 7	8 3 0	9 0 0	9 0 0	9 1 0	9 3 14	3 1 14	8 3 21
3.	1	Fed on pasture, and in hammels, with 9 lb. cake per day.	6 2 14	6 3 14	7 1 0	8 2 0	9 0 0	8 3 0	9 0 14	9 2 0	10 2 0	3 3 14	...
	2		6 2 7	6 3 0	7 1 0	8 1 0	8 2 0	8 2 0	9 0 0	9 2 0	10 0 0	3 1 21	..
	3		6 0 0	6 1 0	6 2 0	7 2 0	8 0 0	8 1 0	8 2 0	8 3 14	9 1 0	3 1 0	10 2 7

cost of hammels about one-third less than that of houses for stall-feeding. The cattle in hammels use a third more litter than those in stalls, but a third less attendance suffices for the cattle accommodated within them than in stalls. Hence, as far as my experience has gone, it is decidedly in favour of the small hammel, or the box with a small yard, as it may be named, with a small quantity of cake, as the best accommodation for feeding cattle. I have, accordingly, adopted it to a considerable extent, in preference to any other plan.

REPORT ON THE COMPARATIVE ADVANTAGES OF SOILING AND PASTURING CATTLE.

By WILLIAM ADAM, Esq., of Ranna, Advocate, Aberdeen.

[Premium—The Medium Gold Medal.]

THE cattle experimented on were *twelve* two-year-old queys, crosses between the Aberdeen and short-horned breeds. They were bought in about the middle of June 1851, and after having been kept on the same pasture till the 10th of July, were divided into three lots (four in each lot) of as nearly the same value as possible, by the reporter's farm-overseer and an experienced butcher, both considered good judges.

The *first lot* of four were pastured out of doors, in a field of excellent first year's grass, consisting of rye-grass and clover, but principally of red clover. The part of the field railed off for this lot consisted of 3 acres 2 roods 6 poles. It was well sheltered on the north and north-east by a belt of thriving wood, and had in it an abundant supply of good spring-water. It had been well laid down after turnips, and afforded a good supply of food for the lot put upon it up to the 12th of October 1851, when they were removed, and very soon after sold, along with the two other lots, to the same butcher.

The *second lot* of four were tied up in stalls, (two-and-two in a stall,) and received daily as much of the same description of green cut rye-grass and clover as they could eat during the same period, (from the 10th day of July to the 12th of October 1851.) They were regularly fed at stated intervals during the day, and watered once a-day, and had an abundant supply of litter. They were also curried once a-day. The extent of ground required to supply this lot with grass, part of which was cut twice, and part three times, was 1 acre 2 roods 35½ poles.

The *third lot* of four were also tied up (two-and-two) in stalls, and received as much of the same description of rye and clover grass cut green as they could eat, with a like supply of water and litter. They were also curried once a-day, and, in addition to the cut grass, each of the cattle composing this lot received daily a

small allowance, by measure, of bruised oil-cake, and of bruised linseed and light oats. The extent of ground required to supply this lot with green provender, during the period of the experiment, was 1 acre 2 roods 35½ poles.

All the three lots throve exceedingly well, but it soon became apparent that the lot receiving the oil-cake and bruised linseed and oats were advancing before the other two lots, although it was doubtful so much as to justify the expense of this food. The progress of the first and second lots seemed so equal during the period of the experiment, that no two judges who saw them could agree as to which lot had the advantage of the other; but the third lot continued to maintain its superiority during the whole period of the experiment.

The four animals composing the *first lot*, which were pastured out of doors, were estimated, at the commencement of the experiment, at £47.

Those composing the *second lot*, fed in stalls in the house on green cut rye-grass and clover, were also estimated at £47.

And the value of the four animals composing the *third lot*, fed in the house in stalls on green rye-grass and clover, with oil-cake and crushed linseed and light oats, were estimated at £52.

At the termination of the experiment, *lot first* was computed by competent judges to be worth £55, 15s; thus giving an increase of value on the lot of— £8 15 0

From this deduct the value of the grass, 3 acres 2 roods 6 poles, consumed by them, estimated at £3 per acre for the season, ...	10 12 3
And the balance exhibits a loss of, . . .	£1 17 3
As the ground, however, was pastured by cattle for some weeks before being railed off for this experiment, in seems fair, on comparing it with the ground from which the grass was cut, to allow a corresponding deduction from the rent, which may be about equal to this apparent loss, . . .	1 17 3
	£0 0 0

Lot second, at the close of the experiment, was by the same judges estimated at £55, 15s.; but the butcher who bought the whole cattle found that this lot turned out to be worth £1 more than lot first, or £56, 15s., thus giving an increase of value of— £9 15 0

Deduct the value of the grass consumed, 1 acre 2 roods 35½ poles, at £3 per acre, ... £5 3 4

Brought forward,	£5	3	4	£9	15	0
Price of 1½ cwt. of guano put upon the ground after the first cutting of grass,	0	15	0			
Price of other 1½ cwt. to be put upon the ground in spring 1852, to compensate for its deterioration in consequence of the grass having been cut in place of pastured,	0	15	0			
Proportion of expense of attendance on the cattle, say	1	5	0			
				7	18	4
Showing a profit of				£1	16	8
To which add the value of the manure produced by this lot, estimated at				2	0	0
				£3	16	8

Lot third, which got the oil-cake and bruised linseed and light oats in addition to the green provender, was valued at the close of the experiment, by the same judges, at £77, and the butcher who bought them at that sum sent them to London, and it is understood he was safe with them, but he said he realised no profit.

The increase of value on this lot was accordingly				£25	0	0
From which deduct the value of the grass consumed, 1 acre 2 roods 35½ poles, at £3 per acre,	£5	3	4			
The value of linseed and oil-cake, £7, 19s. 6d., and crushed light oats, £3, 4s., consumed,	11	3	6			
Proportion of expense of attendance,	1	5	0			
Price of 1½ cwt. of guano put on the ground after the first cutting,	0	15	0			
Price of 1½ cwt. ditto, to be applied to the ground in spring 1852, to compensate for its deterioration in consequence of the grass having been cut in place of pastured,	0	15	0			
				19	1	10
Leaving for outlay and profit on the lot,				£5	18	2
To which add the value of the manure, increased at least to the extent of 10s. over that of lot second by the use of oil-cake and bruised oats,				2	10	0
				£8	8	2

It thus appears that there was a gain on the lot fed in the house on cut grass alone, over the lot pastured in the fields, of £3, 16s. 8d., and that on the lot which received the addition of oil-cake and crushed linseed and light oats, there was a gain over those pastured in the field of no less a sum than £8, 8s. 2d., and over the lot fed in the house, on cut grass alone, of £4, 11s. 6d., proving beyond a doubt that high house-feeding is the most remunerative to the farmer.

It may be proper to add, that as the whole grass on the farm had been pastured by sheep during the winter, and till far into spring, and very closely eaten, it was later in the season before it could be either pastured by cattle or cut for soiling than otherwise it would have been.

REPORT ON THE COMPARATIVE EARLINESS AND PRODUCTIVENESS OF DIFFERENT VARIETIES OF BARLEY.

By GEORGE W. HAY, Esq. of Whiterigg, Melrose.

[Premium—The Medium Gold Medal.]

IN instituting the following experiments, care was taken to have everything so arranged that mistakes might not occur; and although it cannot be said that the sowing, reaping, stacking, &c. were all done by my own hands, yet, as all these and other operations were performed by trustworthy parties, who are in the constant practice of conducting experiments, I trust they will be taken as correct representations of facts.

I think it due to myself to make this statement, as I observe reporters on different subjects vouching for the accuracy of their reports, on the plea that all the manual operations connected with the experiments were executed by their own hands.

It may be premised that this district of country is rather a late one, and the soil generally not well suited for the cultivation of barley, being stiff clay, and better adapted for wheat. The soil of the farm on which the barley was grown is generally a stiff clay, resting on a retentive subsoil, but the field itself on which the experiments were made has a more porous soil than the surrounding lands, and consequently better adapted for barley and turnips. It was selected for the purpose of these experiments, although barley was not the crop which ought to have been the next in rotation.

The principal object of this trial was to ascertain the difference

of value, in several particulars, of barley grown in this late and high district.

The particular field on which the barley was raised is about forty miles from the sea, and 450 feet above its level. It had lain in grass for two years, and previously underwent the usual course of cropping. Its exposure is to the south. That part of it was selected which is of uniform quality, and, after being ploughed, was broken by the grubber, and completely pulverised by harrowings and rollings. The land was then ridged up into 30-feet ridges, and ribbed with 25 ribs on each ridge. One quarter of an acre was then measured off for each of the eight varieties of barley experimented on, and the produce from each of these quarters of acres was weighed in bulk, thrashed, dressed, &c.

The kinds of barley sown were the Peruvian, Annat, Foreign, Italian, Elliot's Prolific, Common, Chevalier, and Six-rowed.

Excepting the Foreign and Elliot's Prolific, the seed was obtained from Messrs Peter Lawson and Son, Edinburgh, from land near the sea-side. The Foreign I had from a neighbour, a farmer and miller, who had purchased a ship-load of it the year before at Leith, and having sown half a field, and being pleased with it, recommended it to me. The Elliot's Prolific I know by no other name. I believe it was first selected and grown by the Rev. Mr Elliot, late minister of Peebles, from seed sent from Italy; and as its produce was much esteemed in that neighbourhood, I obtained a bushel three or four years ago, and have grown it ever since. It has, however, degenerated with me. It was of very fine quality, and heavy when I first got it. The straw is so strong, as to have more of the character of that of wheat than of barley.

The Annat was the most productive in straw and grain of the varieties tested, and the Peruvian the least. The Peruvian has, in my opinion, nothing to recommend it, its straw and grain being less than of any of the others; and although it yields more meal and pot barley than any of them, its dark colour will render it quite unsaleable. As to malting properties, I may state that, by the kindness of an enterprising and skilful brewer in the neighbourhood, the different varieties were tested, and he pronounced the Peruvian the best for the purpose. The price—40s. or 42s. per bushel—at which it was sold last year, would, I fear, prevent both millers and brewers from purchasing it. The straw is liable to break, or rather the heads are apt to be snapped off at the neck by high winds, from the extreme brittleness of the straw in that part. I was much disappointed at the results of the Peruvian, as from the Table it will be seen that it held a high place during the month of July, and until it was reaped.

The Elliot's Prolific also turned out much worse than I had

anticipated; but it seems unnecessary to go over the several varieties in detail, as the Table will at once show the comparative earliness and productiveness of them in the straw and grain, and as well in their mealing qualities as the place each holds in the estimation of the maltster, irrespective of expense. I may mention that the samples were tested in the same way, as the brewer is in the constant habit of testing grain previous to making large purchases.

Of course, it may be easily understood how very different will be a variety grown on very stiff soil—on its blue or red tilly subsoil—from the same variety grown upon a light soil—on its gravelly subsoil—either for its mealing or malting qualities, especially the latter.

The only other remark I require to make is, that the qualities of all the varieties were much deteriorated on account of their having been stacked only for a short time. The reason for this was, that the crop was longer in the field, from wet weather, than it would otherwise have been, and thus little time was left for the thrashing and dressing of it before the period at which this report had to be finished.

Six bushels of each kind were sent to the grinding mill, three bushels of which were made into meal, and three bushels into pot-barley. I saw the several quantities weighed there, and, besides superintending the weighing and measuring at home, I took notes during the summer of the progress made from time to time, as shown in the Table.

TABLE

TABLE OF RESULTS.

Names of Varieties of Barley.	Quantity of seed sown per imperial acre.		Weight per bushel.	When sown.	When brairded.	State of forwardness on 9th May.	State of forwardness on 9th June.	State of the ear on 9th July.	State of earing on 9th July.	State of strength on 9th July.	State of earing on 15th July.	State of strength on 15th July.	When reaped.	Number of sheaves on ¼ of acre.	Weight of straw and grain on ¼ of acre.	When stacked.	When thrashed and dressed.	Produce of good grain from ¼ of acre.		Produce of light grain from ¼ of acre.		Weight per bushel of good grain.	Produce of good grain per acre.		Produce of light grain per acre.		Weight of straw and refuse per acre	Produce of barley-meal from 3 bushels.	Produce of pot-barley from 3 bushels.	Produce of barley-meal per quarter.	Produce of pot-barley per quarter.	Comparative value for malting purposes.
	Bush.	Tenths of bush.	lb.	April.	May.								Sept.	Sheaves.	Stones.	Oct.	Oct.	Bush.	Tenths of bush.	Bush.	Tenths of bush.	lb.	Bush.	Tenths of bush.	Bush.	Tenths of bush.	Stones.	st lb oz	st lb oz	st lb oz	st lb oz	
Peruvian, . .	3	0	60	14th	9th	4th	7th	in ear	2d	4th	2d	2d	12th	181	92	2d	20th	7	1½	0	5	54	28	6	2	0	251	9 13 11	7 13 12	26 8 8	21 4 0	1st
Annat, . . .	4	0	56	14th	9th	5th	2d	notout	5th	6th	5th	3d	23d	205	148	2d	20th	12	3½	1	4	52	49	4	5	6	389	8 6 15	7 9 14	22 9 0	20 7 0	2d
Foreign, . . .	3	8	55½	14th	9th	3d	1st	in ear	4th	2d	4th	6th	13th	188	130	2d	20th	12	4	0	6	52½	49	6	2	4	325	9 2 7	7 2 14	24 6 0	19 3 0	3d
Italian, . . .	4	4	54½	14th	9th	1st	4th	in ear	3d	3d	3d	8th	18th	168	118	2d	20th	11	7½	0	5	50½	47	0	2	0	294	8 8 0	6 10 5	22 12 0	17 13 8	2d
Elliot's Prolific,	4	0	54½	14th	9th	2d	3d	in ear	1st	1st	1st	7th	20th	165	122	2d	20th	12	1	0	6	50	48	4	2	4	308	8 6 9	6 9 12	22 8 0	17 12 0	4th
Common, . .	3	6	54½	14th	9th	7th	5th	notout	8th	8th	7th	5th	20th	174	140	2d	20th	12	5	0	7	52½	50	0	2	8	365	8 7 9	6 10 11	22 10 8	18 0 8	6th
Chevalier, . .	4	0	54	14th	9th	8th	6th	notout	7th	7th	6th	4th	20th	170	130	2d	20th	11	0	0	5	52	44	0	2	0	350	8 8 13	7 3 6	28 0 0	19 4 0	5th
Six-rowed, . .	3	8	53	14th	9th	6th	8th	notout	6th	5th	8th	1st	13th	171	120	2d	20th	11	1	1	7½	50	44	4	7	0	297	8 10 12	6 12 12	23 5 0	18 6 0	3d

REPORT ON THE IMPROVEMENT OF WASTE LAND ON THE FARM OF UREHILLS, ON THE ESTATE OF CULLODEN.

By Mr John Rose, Kirkton, Inverness.

[Premium—Medium Gold Medal.]

At the term of Whitsunday 1840, the reporter became tacksman, under an improving or 31 years' lease, of the lands of Urehills, situated in the parishes of Croy and Daviot, and counties of Nairn and Inverness. Those lands form part of the ancient moor of Drummossie or Culloden, the scene of the last contest for ascendancy between the houses of Hanover and Stuart. At the reporter's entry to the lands the measurement was as follows:—

	Imperial. Acres.	Roods.	Poles.
Arable,	256	3	32
Pasture,	248	8	18
Totals,	505	0	10

The lands, at the reporter's entry, were entirely destitute of houses, fences, and roads, if he excepts one or two miserable hovels or Highland huts, in a dilapidated state, and almost unfit for habitation. Roads there were none, and there was not a single fence; nor was there, nor is there, any plantations, nor any kind of natural shelter or protection—so that the land lies entirely exposed. It has a southern exposure, and is situated on the slope between the ridge of Culloden and the banks of the Nairn, to which it descends very rapidly. The whole lands were, at the reporter's entry, thickly intersected with glens, gulleys, and marshes, requiring deep and expensive draining; and the surface is in many parts very irregular, rendering the lands exceedingly difficult to labour. The farm is about six miles from Inverness, which is the nearest place at which lime, coals, or manure, can be had; and the road to that town is steep, and never kept even in ordinary repair. At the reporter's entry the improved land lay in irregular patches, scattered amongst the unimproved; and stones, the accumulations of centuries, collected from the arable land, were thrown promiscuously upon the adjoining pasture. The entire pasture was moor, overgrown with heather, full of large boulders of granite and other rock, more than one of which have cost the reporter upwards of £5 to remove. The contract for the boring of one of them was £3, 5s. The pasture, with the exception of about ten acres, was utterly valueless, not worth sixpence an acre; and these ten acres were not worth more than 3s. per acre. Besides, the soil had been almost entirely shaved off for turf, fuel, and thatching. The arable land, too,

was in a most wretched condition, reduced to poverty through a long-continued system of over-cropping and gross mismanagement. Indeed, at the reporter's entry he found everything in a condition to discourage and dispirit him. The subsoil is generally strong clay, and the soil heavy black earth. He immediately determined to subdivide the farm; and, in clearing the land, laid down the stones in the lines of the fences. On the arable land he adopted the five-shift system of management—viz.: 1st, Oats; 2d, Rye-grass; 3d, Pasture; 4th, Oats or Barley; 5th, Green crop. The reporter has never sown wheat, as he does not consider the soil and situation adapted for rearing it.

Since the reporter entered, he has improved and brought under cultivation, of what was pasture at the commencement of his lease, 127 acres 3 roods 21 poles, chiefly during the five years from 1845—only 34 acres 1 rood 20 poles having been under cultivation before crop 1846. He has, besides, broken up and cleared of stones 43 acres and 35 poles, all of which are limed, and will be under crop in 1852.

The reporter's system of improving the waste land was this: In the summer, or in the latter end of autumn, he ploughed it up with a large strong iron trench-plough, drawn by three horses abreast, accompanied by two men besides the driver, with crow-bars to raise all large stones with which the plough came in contact, and was unable to remove, and which did not require blasting. The average depth of the first ploughing was ten inches. Immediately after being ploughed, a large strong iron brake, drawn by four horses abreast, and surrounded by a strong iron bar, was put over it to break the turf, tear out the heather, and loosen the stones near the surface. The ground was then exposed to the pulverising influence of the frost and rains throughout the winter. In the course of the following spring, summer, and autumn, it was cleared of stones, drained, trench-ploughed again to the depth of from 12 to 14 inches, and, in the latter end of autumn, limed at the rate of about 24 bolls the acre. The lime was mixed with the soil with the brake-harrow in the ensuing spring, the broken surface harrowed finer, the land manured with farmyard dung at the rate of 40 loads the acre, the manure ploughed in, and the land sown with oats, with the exception of 16 acres, which were so thickly studded with stones that it was impossible to plough them. The reporter has trenched little. He considers trench-ploughing to be at once a more efficient and economical system, and would, in all cases where practicable, unhesitatingly recommend its adoption. The outlay in the improvement of the land already under cultivation has been as follows:—

1. Expense of improving and bringing into cultivation 16 acres which were trenched:—

Expense of trenching 16 acres, at £6, 8s. per acre, . .	£102	8	0
" of blasting stones, 15s. per acre, . . .	12	0	0
" of clearing do., £2, 10s. per acre, . . .	40	0	0
" of liming do., 24 bolls, per acre, 384 bolls, at 2s. 1d. .	40	0	0
" of cartage, and tolls of do., at 5½d. per 7 bolls, .	14	1	1
" of spreading lime on the land, at 5s. per acre, .	4	0	0
" of braking in the lime, harrowing the land, and ploughing down the manure, at 20s. per acre, . .	16	0	0
" of manuring, at 40 loads farmyard manure per acre, and spreading it, at 2s. per acre, . . .	64	0	0
" of sowing and harrowing 16 acres, at 10s. . .	8	0	0
	£300	9	1

Average cost per acre in putting it under crop, exclusive of seed, . .	£18	15	6

2. Expense of improving and bringing into cultivation 111 acres 3 roods 21 poles, of trench-ploughed land:—

Expense of trench-ploughing 1 acre, 3 men at 1s. 6d. per day, for 3 days, ...	£0	13	6
3 horses per day at 3s., ...	1	7	0
Tear and wear of plough and harness, &c., .	0	2	6
	£2	3	0

111 acres 3 roods 21 poles, at £2, 3s., ...	£240	11	11
Cost of harrowing ditto, with large brake, and 4 horses, at 5s. 7d. per acre, ...	30	7	9
" of blasting stones, at 15s. per acre, . . .	83	18	2½
" of clearing off stones, at 50s. per acre, . . .	279	14	1
" of second trench-ploughing, same as first, . .	240	11	11
" of liming at 24 bolls per acre, 2685 bolls at 2s. 1d., .	279	13	9
" of cartage and tolls at 5s. 1½d., per 7 bolls, . .	98	5	9½
" of spreading lime at 5s. per acre, . . .	27	19	5
" of braking in the lime, and ploughing down manure, at £1 per acre, ...	111	17	7½
" of manuring, including cartage, and spreading 4 loads per acre, say at 2s. per load, £4 per acre, . . .	447	10	7
" of sowing and harrowing, 10s. per acre, . . .	55	18	10
	£1896	9	10½

Average cost per acre of putting land trench-ploughed under crop, exclusive of seed,	£16	18	0

In addition to this, the reporter has broken up, and cleared of stones, and limed, 43 acres 0 roods 35 poles, which will be under green crop in 1851. These 43 acres 35 poles were trench-ploughed, and harrowed with the large iron harrow, in the summer of 1848; exposed to the action of the frost, &c., during the winter of 1849; drained, and cleared, and limed, in the course of spring and summer 1850, and now in course of being trench-ploughed the second time, in 1851. The following is the estimate of the expense already incurred in connection with these 43 acres, 35 poles—viz.:

Cost of trench-ploughing 43 acres, 35 poles, at 29s. per acre,	£62	13	4
„ of harrowing 43 acres, 35 poles, at 15s. per acre, . .	32	8	3½
„ of blasting stone on do., at 15s. per acre, . . .	32	8	3½
„ of opening 6666 yards of drains, at 1¼d. per yard, .	34	14	4½
„ of filling do., at 1¼d. per yard, ...	34	14	4½
„ of 1080 bolls lime, (upwards of 25 bolls per acre,) at 2s. per boll,	108	0	0
„ of cartage and tolls of do., at 5s. 1½d. per 7 bolls, . .	39	10	8½
„ of spreading lime, at 5s. per acre, ...	10	16	1
„ of braking in lime, and harrowing do., at 10s. per acre, .	21	10	3
Total sum expended upon the above 43 acres, 35 poles,	£376	15	8½

In this case the reporter has, contrary to his usual custom, limed before the second trench-ploughing. In the statements of the expense of the improvement of the waste land, given prior to the one above, it will be observed that the expense of neither the drainage nor the fencing is included.

In reference to draining, the reporter unfortunately is not able to distinguish, from his accounts, between the drains upon the original arable lands and those constructed by him upon the lands which he has improved. He may, however, mention, that on the original arable and improved land he has constructed—besides those finished in 1850, and included in the foregoing statement of outlay—a little more than thirty-six miles of drains—viz.:

45,800 yards, 30 inches deep, at 1d. per yard, for cutting,	£190	16	8
8300 do. of do. at 1¼d. do. do. .	43	4	7
3000 do. of do. at 1½d. do. do. .	18	15	0
4000 yards of 3 feet deep, at 2d. per yard, 2 feet wide at bottom, ...	33	16	8
4000 do. of 3 feet 3 inches deep, at 3d. per yard, .	50	0	0
	£336	12	11

And taking the expense of filling, including cartage, breaking of stones, &c., at the same rate as the cost of cutting, the entire cost for drains on the farms will be £672, 5s. 10d.

In reference to fences, the reporter has constructed 7150 yards of double stone dykes 4 feet high, with a Galloway cope 1 foot high—in all 5 feet high, at the following cost:

Cartage of stones, &c.—7150, at 7d. per yard, . .	£208	10	10
Building 7150, at 7d. per yard, ...	208	10	10
	£417	1	8
And also 770 yards of single dykes, backed with earth, at an outlay of 2½d. per yard, amounting to, ...	£8	0	5
Cartage of 770 yards, at 4d. per yard, . . .	12	16	8
Building 770 yards, at 4d. per yard, . . .	12	16	8
Total, ...	£33	13	9

Making the entire cost of fencing £450, 15s. 5d.

The reporter has also to state that he has erected, at his own cost, an extensive, new slated, square steading, at an outlay of about £800, and he has to add that the whole improvements have been effected at his own expense. The reporter, not contemplating

sufficiently early the requirements of the present report, is unfortunately unable to give the returns of produce with that detailed accuracy which he would have done, had he had the present report in view from the commencement of his operations. He believes, however, that the following is sufficiently near the truth for all practical purposes—at any rate, it is as near as his books enable him to come: Produce of the first crop of oats on 127 acres 3 roods and 21 poles, 560 qrs., sold at £721, 14s. Produce of second crop in do., rye-grass.

This was pastured, and it is rather difficult to estimate the value; but he had a capital crop of rye-grass, and he does not think he is overstating the value (looking at the price given for rye-grass in the immediate neighbourhood) at 50s. per acre, which for 127 acres 3 roods and 21 poles, is £319, 12s. 7d. It is equally difficult to arrive at the value of the third crop; but he knows he is not overstating it, from the returns of the sales of his cattle, at 25s. per acre, which is £159, 16s. 3½d. The returns of the fourth crop were as follows: 513 qrs. 4 bush. oats, sold at £589, 19s. The produce of the green crop has been as follows: 81 acres 2 roods 21 falls, eaten off with sheep, at £3, 10s. per acre, £286, 1s. 2d. He has had the same gentleman's sheep for the last ten years, and during the whole of that period the price has been £3, 10s. per acre.

The value of the 46 acres 1 rood, which were consumed by his cattle and horses, he estimates at £3. He believes it did not pay him so well as that which was eaten off with sheep. 46 acres 1 rood at £3 = £138, 15s.—in all, for green crop, £424, 1s. 2d.

The reporter has only to add, that in all cases he looks upon lime as indispensable for reclaimed land, before being put under crop.

ABSTRACT OF THE COST OF IMPROVING, AND OF THE VALUE OF THE PRODUCE.

Cost.

Cost of improving 16 acres,	£300	9	1
... ... 111A. 3R. 21P.,	1896	9	10½
... ... 43A. 0R. 36P.,	307	7	0
... draining,	742	14	6
... fencing,	442	15	0
... steading,	800	0	0
	£4489	15	5½
Rent, interest, &c.			

Produce.

Oats,	£721	14	0
Rye-grass,	319	12	7
Pasture,	159	16	3½
Oats,	589	19	0
Turnips,	424	1	2
	£2215	3	0½

ON HYBRIDISATION OF WHEAT.

By Mr Hugh Raynbird, Freefolk Priors, Andover Road, Hampshire.

[Premium—The Medium Gold Medal.]

New varieties of our cultivated plants generally owe their introduction to accident, rather than to a systematic plan continued through a long series of years. A farmer is struck by the appearance of a few ears of corn, either growing in the corn-field, or, what is more generally the case, in some place where the soil and circumstances are favourable to a luxuriant growth: he preserves the seed, and in a year or two introduces it as a new and improved variety; or he may select a large and well-shaped root from his turnip-field, and rear a stock of seed from it. Such is the usual method, and it is one that has been adopted with much success by some farmers. But though careful selection and cultivation may alter the appearance and growth of a plant, and improve its produce or quality, yet it can hardly be adopted as a means of introducing new varieties, but rather to improve those we already possess. In the same manner as the judicious breeder selects his cattle for those properties which experience tells him will be imparted to their offspring in greater or less perfection, in proportion as the system of feeding is judicious or injudicious; so the seed-farmer finds that the acquired luxuriance or quality of a single plant is continued by its seed, in the production of similar plants in greater or less perfection, according as the soil, climate, and season are favourable to the growth of that plant.

Much has been done by improving the various breeds of cattle; yet if as much care was taken in the judicious selection of the agricultural seeds as of the live stock throughout the country, I have no doubt but the result would be equally satisfactory. It is a matter that demands our serious attention; for if we can add, by this means, one bushel to our produce per acre, it will, in the aggregate of the whole country, become an item of vast importance. In very many cases have I seen the produce from seed of a good variety exceeding the produce of another variety, growing side by side, to the extent of seven or eight bushels per acre; and the same with roots, to the extent of as many tons. Thus it seriously affects the individual; and when this is spread over a great number of acres, it becomes of vast importance to the public that only the best and most productive sorts of agricultural plants should be cultivated.

I shall now allude to the effects of hybridisation upon wheat, by which I have succeeded in obtaining several varieties far more distinct in their manner of growth than could possibly have been

obtained from mere selection or cultivation. This hybrid is the result of the impregnation of the stigmas of the "Piper's Thickset" with the pollen obtained from the anthers of the Hopetoun wheat.

I date the commencement of my experiment from the autumn of the year 1845, when I planted a few grains of the Piper's Thickset—a wheat then but lately introduced, and strongly recommended by Mr Piper of Colne Engaine in Essex. It is a coarse variety, with a short thickset ear, very unlike most of the cultivated sorts: it possesses some remarkable qualities, which render it peculiarly adapted for marking the effects of impregnation, and, at the same time, of affording the means of obtaining an improved variety, by crossing with a kind of wheat possessing opposite qualities.

The Piper's Thickset, besides having a peculiar formation of ear, possesses a short and stiff straw, and therefore it is a good sort to grow on rich loams, and all highly cultivated soils that produce straw too abundantly, upon which the weak and long-strawed varieties are liable to lodge; but on poor soils the short straw is a great objection, for it is well known by all the farmers of poor land that a crop of corn cannot be secured without a crop of straw, and hence preference is always given to a long-strawed wheat.

The result of Professor Way's analysis of the Piper's Thickset, in the English Agricultural Society's Journal, bears out the opinion I had formed of this wheat.

I may describe the Pipers as a coarse red wheat, with a short close-set ear, that is very liable to be broken off if the crop is allowed to remain uncut till it becomes over-ripe; and the stiffness of its straw renders it peculiarly advantageous upon rich soils, upon which it has produced very abundant crops; but though it possesses this advantage to a greater extent than other kinds of wheat with which I am acquainted, yet the grain is not of that quality which will be approved of for general cultivation. With the view of improving the quality of the grain, I selected the Hopetoun, a wheat, as I said before, of very opposite qualities. This is a well-known and approved variety, introduced by Mr Patrick Sheriff from a single ear; and it is a white wheat, with a long ear, containing more than the average number of small grains of a fine quality: the straw is long.

It is as well to observe, previously to describing the method of impregnation, that though I chiefly selected from the Hopetoun, yet I did not entirely confine myself to that kind, but took any variety of an opposite quality to the Pipers, which happened to afford the pollen in a fit state for application to the stigmas of the variety of wheat which I wished to impregnate.

The method which I adopted is somewhat similar to one which

I remember to have read in one of the volumes of the Transactions of this Society.

As soon as the Piper's Thickset came in ear, I opened each glume, and removed the three anthers, which form the male part of the blossom, upon the point of a needle. I allowed the glume again to close over the stigma or female part of the blossom, which remained uninjured. As the ears made their appearance, I performed this rather tedious operation upon each of them; and two or three days afterwards, having taken from the fields a few ears of the Hopetoun, or any other kind which presented the pollen in the best state for my operation, I again opened the glumes, and dusted the stigmas with the pollen from the anthers of the selected ears. This completed the operation; but the manipulation of art never equals nature's handiwork. In many of the glumes the corn did not fill at all; and I only obtained a few miserably thin kernels from each ear. But even this was more than I expected to get. I planted these in September 1846, and in the January following, in order to increase the produce, I divided the roots, and replanted the crop upon a larger piece of ground. At harvest, all the ears had the red chaff and grain of the Piper's Thickset, and many of the ears were not changed at all; in some only the upper part of the ear resembled the Pipers, whilst others resembled the Hopetoun in the length of the straw and shape of the ear. In the autumn of 1847, the greater part of the produce was dibbled upon a light gravelly soil, and the crop was stored in a granary that was unfortunately destroyed by fire in September 1848. However, eight of the best ears of the hybrid had been forwarded into Gloucestershire, a distance of more than a hundred miles, and had there been carefully cultivated, of which I am able to give the following details:—

TABLE NO. I.

Transplanted Corn grown on Gravel.	No. of Corns.	Weight in Grains.
Ear No. 1	93	69
.. 2	95	64
. 3	81	53
... 4	65	42
.. 5	84	44½
... 6	91	56½
... 7	75	46½
... 8	60	36

In the above table is shown the number of corns contained in each ear, and also their weight in grains. It will be seen that the number of corns is considerably above the average.

On October 8th, 1847, I dibbled the corn taken from these eight ears upon a piece of deep sandy loam, having an altitude of some-

thing like 500 feet above the level of the sea: upon this unsheltered spot the crop received no extraordinary attention during its growth, but the seed had been planted upon a system resembling the one recommended by Mr Morton of Whitfield, as a means of securing exactness, by having two boards, each 6⅓ inches wide, perforated with holes to admit the dibble 5 inches apart, so that each plant occupied a space of half a link, or the 200,000th part of an acre; or, by omitting every other hole, the space was increased to 2 links. When one row was planted, the second board was shifted forward; and in this manner the most minute exactness was secured.

The plant was up on October 19th, was deeply hand-hoed on May 11th, 1848, and cut August 15th, 1848.

Both the straw and grain were carefully weighed, and the results of the experiment are given below in a tabular form:—

Table No. II.

	Planted.						Produce.					
	Number of ears.	Number of grains.	Weight, grains apoth.	Number of seeds in each hole.	Distance apart.	Quantity of land	Weight of straw and grain.	Weight of grain.	Proportion of straw to grain	Weight of straw and corn per acre.	Weight of grain per acre.	Weight of seed sown, Rate per acre.
					in. in.	sq. links.	lb.	oz.		ton. cwt. lb.	st. lb. oz.	lb. oz.
No. 1.	1	93	69	1	12⅜ to 10	186	11	45	2.91	2 12 90	108 0 0	6 5¼
2.	1	95	64	1	6⅛ ,, 5	47	4½	19	2.79	4 5 54	180 6 0	23 8
All.	8	644	411½	1 & 2	6⅓ ,, 5 & 12⅜ ,, 10	565	39	189	3 06	3 1 70	149 5 2	12 7½

The quality of grain of the hybrid wheat, grown from these eight ears, cannot be called very superior, but it surpassed the Piper's Thickset, and many other varieties growing by its side, under similar treatment; and if we take into consideration the thin-seeding, the elevation of the ground, and the unfavourable weather which occurred between the 15th and 30th of September, during which time the grain was in the field, I think the produce is very satisfactory. I again made a selection from the grain, and hope next year to have an increased produce to carry on my experiment upon an enlarged scale. As a matter of course, the raising of a new variety by hybridisation (even when free from the accidental drawback which occurred to my experiment) must require several years before it can be tested by field cultivation, as it is impossible to carry the minute and tedious manipulation of hybridisation to any great extent.

PLANTING ON PEAT-MOSS.

By Mr Peter Mackenzie, West Plean, Stirlingshire.

[Premium—Five Sovereigns.]

Peat-moss, in many parts of Scotland, does more harm than good, when nothing is done to remove it, or to improve its surface. Agriculture is yearly improving the soil and climate of our country; but while so many thousand acres of cold wet peat remain untouched by the hand of culture, plague-spots will exist to upbraid us for our neglect of improvement.

Peat-moss, from time to time, has been turned to many uses; but without enumerating these, I shall confine my remarks to the planting it with useful trees.

Condition of the peat-moss in its original state.—The peat-moss, about which I intend to make a few observations regarding the progress of the trees that have been planted upon it, has been formed in a hollow part of the country, the hollow being probably a lake at one period, the deepest part of which has been ascertained by means of boring to be about 15 feet deep, and a cut about 10 feet deep through it has enabled us to witness its various formations at one view.

The moss rests upon a fine sandy clay, the open surface of which is dark coloured, arising from a mixture of finely-decomposed peat.

The first formation of peat appears to be composed almost entirely of cryptogamic vegetation, and I believe that *Sphagnum obtusifolium* and *S. acutifolium* may be distinguished; also a species of polytrichium, mixed with some long flat leaves, perhaps the remains of a sparganium, bur-weed, or some species of carex. This formation is about 18 inches thick.

The second formation is composed, for the most part, of partially decayed woody matter, such as the common birch (*Betula alba*,) hazel-nut (*Corylus avellana*,) common alder (*Alnus glutinosa*.) This bed is about 2 feet thick. It is seldom that any remains of fungi are found in peat, or anywhere else; but in this stratum, some years ago, I found a specimen of boletus, which I sent to the late Professor of Botany in Edinburgh, Dr Graham, who informed me that it was a boletus; but the specific name was not given. Upon the upper surface of this bed the pine found a footing, and, judging from the remains left, some of them must have attained considerable size, and, we may suppose, had been used by man at a remote period for some purpose or another, for wooden wedges have been found, as also charred wood, among the remains of the pine-wood.

The third formation is about 15 inches thick, and in it the pine-trunks and remains of other trees are found, and sometimes also

the remains of their roots. The vegetable matter is so much decomposed, that it would be difficult to say what the vegetation was in which the trunks are imbedded, but, to all appearance, of a mixed nature, composed of coarse grasses, heath, and mosses. The peat formed by them is somewhat solid.

The fourth formation is of a light spongy nature, and upon its surface the vegetation of the present day exists; sphagnum appears to abound in it; and perhaps the light-brown colour of newly-formed peat may be owing, in a great measure, to this light-coloured moss. The remains of heath also are found, and what appears to be old withered blossoms are abundant.

The moss at one time had been of greater extent than at present, part of it having been removed for various purposes: a part is under cultivation, a part has been planted at different periods, and a small portion remains in what may be called its original state; so that the part upon which we intend to make our remarks, extending over a surface of upwards of 7 acres, is divided into four unequal portions.

The first division covers about two roods and a-half, and is still in what may be considered its original state, as far as planting is concerned; but, rising to the main ditch on the one side, and a cultivated field on the other, and the smallness in breadth of the portion, moisture must sooner have passed from it than if the extent had been greater and the drainage less.

There are also native plants on it which are not found on peat-mosses farther removed from cultivation. Owing to these circumstances, the difference between the planted and unplanted peat may not be so great in some respects as may be expected.

The following is a list of the native plants found growing on that part of the moss which has not been planted by man:—

Calluna vulgaris, common ling.
Erica tetralix, cross-leaved heath.
Vaccinium myrtillus, whortle-berry.
Rumex acetosa, common sorrel.
——— *acetosella*, sheep's sorrel.
Gallium palustre, white-water bed-straw.
Tormentilla officinalis.
Viola palustris, marsh violet.
Geranium robertianum, herb Robert.
Ranunculus repens, creeping craw's-foot.
Rubus cæsius.
Angelica sylvestris, wild angelica.
Bellis perennis, common daisy.
Senecio jacobea, common ragwort.
Alnus glutinosa, alder.
Salix cinerea, grey willow.
Corylus avellana, common hazel.
Pinus sylvestris, Scotch fir.
Luzula pilosa, small hairy wood-rush.
Juncus effusus, soft rush.
Carex, several species.
Eriophorium angustifolium, common cotton grass.
Holcus mollis, creeping soft grass.
Aira cæspitosa, turfy hair grass.
Festuca ovina, sheep's fescue grass.
Anthoxanthum odoratum, sweet-scented vernal grass.
Mosses, several species.

The second, and by far the largest division of the peat-moss, was planted upwards of forty years ago. We may here remark that the native plants on this part of the peat, from the main ditches inwards to about 30 yards, are the following:—Among

the grasses are species of *Holcus*, *Festuca*, and *Agrostis*; the raspberry and bramble are common, also the wood-sorrel, with the common and sheep's sorrel; the enchanter's nightshade may be found, and the ragged robin; also species of the willow herb, (*Galium saxatile*;) the *Vaccinium myrtillus* is abundant; in the hollows the polytrichium and sphagnum abound. In this part of the moss the common ling (*Calluna vulgaris*) is dwarf, and not very abundant; but in what may be called the inner circle, where moisture abounds, it is the main crop. The cultivators of Cape heaths may learn something useful by observing such a circumstance among our native plants.

Before this part of the moss was planted, a deep ditch was made to drain off the superfluous moisture, and in some parts the ditch is 10 feet deep. The surface was somewhat irregular; here and there are hollows that contained water, and had no outlet; in other places the peat rose into small knolls, so that in draining the moss no regular system of drainage was followed, drains being made in every direction that would carry off the water to the main ditch. In places where it was very wet, a greater number of drains were made than in those parts which were considered more dry. Where there was little fall, or a dead level, drains were cut across one another to let the water away as easily as possible; and when there were boggy places, a drain was brought up through them, and the water escaped. In some places the holes were but partially drained, they being deeper than the drains. The smaller drains were left open, having been made about 3 feet deep, 2 feet wide at top, and 1 foot wide at bottom; but they are not that depth now. Vegetable matter soon accumulates in such drains, if not removed; and it is in the nature of peat-moss, when water is withdrawn from it, to subside considerably.

The subsiding of peat-moss after draining is a subject that cultivators ought to attend to particularly, for, by doing so, both money and labour may be saved to a considerable extent in future years. Some years ago, a part of a garden consisting of peat was drained, and in bringing up the leading drain a deep cut was required to be made, which was afterwards built and covered with strong flagstones, and the earth filled in again, to level up the ground where the cut was made. The drain did well for some years. Drains were also made in the peat in the garden, and the water led into the main drain; but the peat in the garden has subsided considerably since it was cultivated, so that the tops of the drains are every year getting nearer the surface: so a time may come, if the ground continue to be cultivated, that the drains may be of very little use, and to deepen them again would require great labour and expense, as also in opening the main drain, and deepening it, and in raising the surface of the garden with fresh material, which would now be very inconvenient.

Main drains or ditches in peat should be made deeper at first than what may seem necessary at the time they are made, for the extreme depth may be required in a few years, if the surface is brought under cultivation; and even if the surface is only planted, it will be found to subside considerably after the water has drained off, and the trees attained some size.

The peat-moss about which I am making these remarks has subsided in some places about 4½ feet. Near the edge of the main drain it is 4½ feet lower than at 50 yards from the drain. At other parts of the moss, where the drainage is less perfect, the sinking of the moss varies.

Different opinions are held by practical men respecting the draining of peat-moss; some recommend 10 inches for the depth of the drains, others as much as 10 feet. It is, however, as possible to overdo as to underdo the draining of peat, much depending upon the object intended, and the sort of crop required from it. I have obtained excellent crops of seedling plants, of the brassica family, upon undrained peat in summer, especially when the summer was hot and dry, when the surface of the peat was almost as dry as tinder; yet the moisture was as near the surface as to be sufficient to nourish the young plants without watering them; whereas, at the time, similar plants on other soils required frequent waterings to keep them alive. But such moist peat would not do for forest trees to grow in; they might live, but would make little progress as timber trees. It is possible, on the other hand, to drain peat to such a degree, that trees would do little good in it from want of moisture; and some mosses have been rendered useless on that account. Where light flow-moss is intended to be planted, and drains to remain open, I would recommend the draining to be done gradually, as the moss subsides, so that the trees may have moisture to sustain them, whilst at the same time the stagnant water, which injures the fibres of the plants, should be removed. The main drains might be made at once, so that only the smaller ones would require to be cleaned or deepened occasionally. Too much moisture evidently hinders the growth of trees on moss. In the first week of June, in 1851, after nearly a month of dry weather, I endeavoured to ascertain the quantity of water in the peat at 1 foot from the surface, and 2 yards from the main drain, the surface, where it was not covered with vegetation, being as dry as dust; and I tried to dry my specimens to a similar state, upon a hot plate, without charring them. This peat contained 76 per cent of water. At 30 yards from the main drains, and 1 foot from the surface, it contained 80 per cent of water. At 70 yards from the main drain, and 1 foot from the surface, it contained 84 per cent of water; and at 150 yards from the main drain, and 1 foot from the surface, it contained 86 per cent of water.

Water prevents the roots from penetrating downwards in search

of food. In some places, where the peat is well drained, the roots go down more than 4 feet; whereas, in those places where the peat is full of moisture, the roots keep very near the surface. Water also keeps the peat cold. In the beginning of June 1851, where the trees were healthy and the peat best drained, the leading shoots of the Scotch fir were 6 inches long, while those where moisture abounded measured only 1 inch.

In all places where trees are wanted to be planted in peat-moss, it should be made as compatible as possible to the nature of the tree before it is planted. Natural philosophy teaches the planter many useful lessons, if he chooses to attend to them; and the more he knows about the nature of heat and cold, as they exist in the earth and air, he will become the better planter for it. In the choice of a farm or garden, much may be done by wise management to improve the soil and increase the temperature of the place; but it is not easy banishing cold from peat-mosses, many of them being placed on low flat land, and in hollow parts of the country, so that they are sure to receive the largest share of the coldest deposits from the air—the cold air of the mountains rolling down their sides to the hollowest place below as quickly as it is formed. Hence the fact, which to many seems surprising, that what are called sheltered places are in spring and autumn the coldest. In the *Theory of Horticulture* we are informed that the dahlias, potatoes, and kidney-beans of the sheltered gardens in the valley of the Thames, are killed in the autumn by frost, whose effects are unfelt on the low hills of Surrey and Middlesex. Mr Daniell says he has seen a difference of 30°, on the same night, between two thermometers, placed, the one in a valley and the other on a gentle eminence, in favour of the latter. The same may be said of the valley of the Forth, where tender flowers will be killed, by means of frost, near the level of the Forth, in spring and autumn, while the same kinds will not be injured in situations as high as the summit of Stirling Castle. Young trees are often much injured, and sometimes killed, that are planted in hollows, whilst those growing in the same situation, but whose summits are 40 or 50 feet high, are not at all injured. We remarked this particularly in the larch, in the spring of 1850, when a sharp frost towards the end of May, when the larch was in full leaf, many young ones, about 6 feet high, were greatly injured, some of which never recovered; others lived, but will never make good trees. They were planted on peat, in hollow ground, while long larch trees, in the same locality, were not injured. Many young larch trees, of the same size and age, did not appear to be hurt with the frost that killed the others; so there may be among larches, as there are among potatoes, varieties that will stand the frost better than others; but such sudden checks given to the sap may have some share in laying the foundation of that disease by

which so many larch trees die before they arrive at their maturity; but where it is known that cold air rolls down the sides of hills like water, precautions should be taken, if practicable, to have the peat in the plains as dry, and then of course warm, as the health of the vegetation on it will permit.

Trenching, levelling, &c.—Under these heads I have little to say, for after the drains were made, there was scarcely anything done to the surface, the hollows not being filled up, nor the surface levelled, no digging or trenching having been done; but after the ditches or drains were made, and the water drawn from the boggy places, the young trees were planted among the heather. The greater proportion of the trees were Scotch firs, but other kinds of firs were planted, as well as some kinds of hardwood, which we will notice afterwards.

We may here remark that there is a marked difference between the trees planted near the edge of the drains, and those a few yards back from them. Any one may learn from such a circumstance, that, to have a greater quantity of timber on the acre, all that is required is a little more draining, which would not cost much at the present day, when sandy clay, and soils of a similar nature, can be opened for drains 2 feet deep at ninepence and a shilling per chain. The drains in peat may be done for less; so that all the difference in growing a tree little better than a walking-stick, and another with 14 feet of timber in it, in the same kind of peat, and in the same space of time, is only allowing a larger quantity of water to remain in it, but which could have been set free at the cost of a few shillings.

Mode of planting.—The mode of planting that has been practised in this neighbourhood for many years for young trees, is that of making pits for the hardwood plants, and of slitting or T planting for the fir plants. There is every probability that the plants were put in, in a similar manner, in the part of the peat-moss on which I am making my remarks. At all events, plants of a similar nature were planted in this manner at a later date in another part of the moss, which I shall notice shortly. The plan appears to do well enough in soft soil, for when the plants take with the soil, they come away freely. Peat is an excellent soil to transplant young trees from, few of them dying, if the least care is bestowed on the lifting of a ball of peat at the roots of the transplanted plants. Such a ball is of great benefit in retaining moisture for the fibres of the plants, until they get time to search about for more in different quarters. For this reason, where peat can be easily obtained, most transplanted trees and shrubs will be the better for having a little put about their roots.

Size of the plants.—It is of some importance to have well-rooted plants from the nursery, for many a failure arises from using inferior plants; and owing to this circumstance, country gentlemen who

raise their own forest trees are sometimes not gainers in the end. I have seen an out-of-the-way corner set aside for a nursery, where neither the soil nor the situation were at all fitted for the rearing of seedling plants. Such ground, too, is often shaded by trees that almost surround it; and weakly-drawn plants from it are not at all fitted for standing in exposed situations, or in places, such as peat-moss, that are liable to early autumn or late spring frosts.

As far as my experience and observations go, I have always found those plants do best that were raised in a light or sandy soil. Such plants are generally well rooted, and have more fibres than those grown in more stiff soil, and they are also more hardy, and better able to endure rough weather in the earlier period of their growth.

The plants that were put in here were transplanted, and not seedlings from the nursery, the Scotch firs being about 9 inches, the larch from a foot and a half to 2 feet, spruce 9 to 12 inches, oak from a foot and a half to 2 feet and a half, and elm, birch, ash, and alder, about the same size.

Some prefer smaller plants for planting where the soil is shallow, and the drought of spring causes the cut to open, to the injury of the young plants; but where there is peat-moss to plant, there are commonly heath and coarse grass; and if small plants are put in in such places, they are often suffocated, and a dry spring has little effect in depriving the young plants of moisture.

I shall now enumerate the kinds and numbers of trees per acre planted in peat-moss, and shall state their relative progress and value, when compared with plantations of a similar age and description, grown on other soils in the vicinity.

Scotch fir—Pinus sylvestris. As I have already stated, the greater part of the plants planted on the peat were Scotch firs. The plants were put in about 4 feet apart, so that 2,722 plants were required for the imperial acre, if all the surface could have been planted; but allowance must be made for the open ditches, which will reduce the number some hundreds. I am not aware whether or not the deaths were made up for the first four years; but where that was done, about half the number more of plants were required. An imperial acre of drained peat-moss may be planted with fir for £1, 18s., and where the plants may be upheld for four years, an acre will cost £2, 17s.; but forty years ago plants were much dearer than they are now, so that an acre planting would then have cost about a third more than at the present day.

A considerable number of the Scotch fir-trees contain 14 feet of timber, which will bring in the market one shilling and one shilling and twopence a foot, which makes the value of the tree at least fourteen shillings: there are some of that size on the moss at 10 feet apart, at which distance there are upwards of 400 trees upon the acre, which would be worth £280; but that distance apart is

too little to have healthy trees, or trees that will not injure one another. When Scotch firs are allowed to grow too thickly together, they seriously injure one another; and, when crowded, the lower branches soon die, and dead branches tend to the loss of the tree in various ways. The living branches then are drawn upwards, so that they cannot spread horizontally, which is characteristic of this tree when standing alone, and having room to grow. One thing, however, generally obtained when the trees are a little crowded, is the straight stems, which increase the value of such wood.

The situation of the trees which I intend to compare with those grown on the peat, is only a few feet above the level of the peat-moss, and in close connection with it. The soil is not the best, yet thousands of acres of worse soil are planted in Scotland. The surface soil is not deep, and the subsoil is tilly. The trees are of the same age as those on the peat, and I have taken the best specimens of each on the different soils.

A Scotch fir upwards of forty years old, on peat-moss, has a diameter of 1 foot 5 inches, at 18 inches from the ground, and a height of 45 feet.

A Scotch fir, on clayey soil, has a diameter of 1 foot 3 inches, at 18 inches from the ground, and a height of 45 feet.

Judging from the appearance of both trees as they stand, the one on the peat has a more healthy appearance than the other; and, if both were left to grow, it would live many years longer than the other. In the peat soil, few deaths have occurred among the old trees; in the other, they often die before they are cut down.

Larch—Pinus larix. The number of larch trees planted in this part of the moss never had been great, but those planted in different parts show what may be obtained by planting them in peat. A few scores here and there among the other plants are all that have been planted, and they seem to have been treated in the same way as the Scotch firs; but in peat, as in most other plantations, the larch takes the lead for a number of years, and then, in too many instances, it dies before much benefit can be derived from it. It is different, however, in the case of the larches planted on peat, as they not only took the start at first, but still keep it. Some of the best trees contain about 36 cubic feet of timber, and such trees, when sound, always bring a good price in the market; and it is somewhat surprising that, when larch gives way in so many soils and situations, and yet remain good on peat-moss, that more are not planted in moss; and whenever a larch tree is wanted for a particular purpose, it is always taken from the peat-moss in this place.

Like the Scotch fir, the best trees of the larch are found in that part of the moss which is best drained; and although the water at times may cover part of the roots, it gradually

subsides, so that it does not remain in a stagnant condition. In its ebbs and flows, it seems to benefit the plants, by keeping them in a healthy state.

Where larch is planted by itself, perhaps putting it a little wider apart than the Scotch fir would be an advantage to it, as it soon spreads out its branches; and when one tree is prevented from hurting another, they all make greater progress in the formation of wood. If planted at 5 feet apart, 1,742 plants would fill an acre. We may here notice that, when drains run north and south, the plants on the east side of the drains will be none the worse for being planted a little farther from the side of the drain than those on the west side, because we sometimes meet with trees upset on the east side, and seldom any on the other side, of a drain; and I imagine, that as our heavy winds generally come from the west, and trees commonly throw out roots in greater strength and number in the direction from which the greatest force of the wind comes, the ditch prevents the roots from going to the westward, and trees without good roots cannot be expected to hold their heads upright among their neighbours. When larch takes with any soil, they soon make rapid progress, and require thinning; the bark of which thinnings may be sent to the tanners, and the peeled trees converted into hurdles. In a few more years, if the trees are attended to, by keeping them from injuring one another in the branches, and removing stagnant water, they will soon become useful for agricultural purposes and pit-wood. When twenty or twenty-five years old, there may be 700 or 800 trees upon the acre, and each on an average worth a shilling for pit-wood; for it can be used for that purpose in many places, when it measures 3 inches across and upwards.

If they are allowed to grow a little longer, they soon become fit for railway sleepers; and the demand for them for such purposes will likely continue; and on some railways the stone blocks are being removed, and replaced by larchwood. Others may be left both for shelter and ornament; for larch trees, containing each 50 or 60 feet of timber, are pleasant objects to look upon, and many a storm they assist in turning from man and beast, that live within the influence of their shelter. Each tree is worth a pound or thirty shillings; and a hundred and fifty of such, upon an acre of peat-moss, is something valuable to possess in time of need; for larch timber can be turned to many useful purposes, although it is no great favourite with the carpenter when not properly seasoned.

Larch trees upwards of forty years old, in peat-moss, have a diameter of 1 foot 9 inches, at 18 inches from the ground, and a height of 50 feet. On other soils, a few feet above the level of the peat, and of the same age, they have a diameter of 1 foot 2 inches, at 18 inches from the ground, and a height of 50 feet.

The trees on the other soil, and of the same age as those on the peat, are not in a healthy state, and very few now remain of them; and they may be cut down at any time, for any farther advantage to be derived from them. Those on the peat soil may live for a long time to come, indicating no sign of disease or decay.

Spruce fir—Abies excelsa. Where the spruce fir has room to grow, some beautiful specimens may be obtained in soil that is suitable for them; and as it delights in moist situations, it may be planted in peat-moss with advantage. We are told that this tree is considered by the wandering tribes of high northern latitudes as a certain sign of the presence of springs of fresh water, as it is only seen in moist and spongy places. Like the larch, only a limited quantity had been planted on the peat here, forty years ago; but they have done well where they had room to grow, and do much better on peat than on many bleak situations where they are planted. Monteath, in the *Foresters' Guide*, tells us that the spruce fir—or pine, as it is called in Norway, and by many in this country—is much better timber than many consider it to be; for although appearing very knotty and coarse when cut up into boards, it makes most excellent plain deal doors, flooring, and scantlings; and although cut into thin boards, it does not warp in the same degree as the other kinds of fir do, although the reverse is generally dreaded. This tree is esteemed of great value by the Norwegians, because it grows very fast; and although used at forty years of age, it is then equally useful as when eighty years old.

A spruce fir upwards of forty years old, on peat-moss, has a diameter of 1 foot 7 inches, at 18 inches from the ground, and a height of 45 feet.

On other soil, at the same age, it has a diameter of 1 foot 1 inch, at 18 inches from the ground, and a height of 45 feet.

It is possible to plant spruce in soil that is too moist; for here, where it is planted in peat, about 30 or 40 feet from the main ditch, in a moist state, the trees measure only 11 inches in diameter, and 40 feet in height.

The spruce firs on the other soil are not in a very healthy state. They may live for some years to come, but appear set in the growth, and will never yield heavy timber.

Alder—Alnus glutinosa. The alders were planted in a hollow part of the moss that could not be very well drained, and at some seasons the peat, in consequence, is very wet; yet they have made considerable progress. Two or three scores of plants are all that have been planted, and several of them have been cut down from time to time as required; but we may observe, that there are few soils that will not suit some kind of tree; and in planting it is recommended that trees be planted in such soil as they will best thrive in, or the ground made conformable to the healthy condition of the plants.

Common alders, upwards of forty years in peat-moss, have a diameter of 1 foot, at 18 inches from the ground, and a height of 35 feet.

On clayey soil they have a diameter of 8 inches, and a height of 30 to 35 feet.

Evelyn tells us that the alder is, of all others, the faithful lover of watery and boggy places, those most despised weeping water-dales of forests.

Birch tree—Betula alba. The birch has sometimes been called the "Queen of Scottish woods;" and Twamley says, that

> God crowns the tree with loveliness,
> A bonnie queen to be;
> Queen of the glens of auld Scotland,
> The bonnie birken tree.

But although it grows on "crag and cleft and dim defile," it will also grow where other trees of the wood will, on peat-moss, and may still be planted as an ornamental tree among others, or even for profit; for, when sold, every sprig of it is used, and finds its way into many a workshop, from the maker of penny dolls to that of "birk besoms." I have no trees of the same age to compare them with those on the peat.

Birch upwards of forty years old, on peat-moss, has a diameter of 1 foot 3 inches to 6 inches, and a height of 45 feet.

The best trees are where the moss is well drained.

Common elm—Ulmus campestris. The elm does not thrive very well where the soil is dry and gravelly, neither does it affect soil that is wet and spongy. It does not appear to do so well on peat as some other trees; still it has made some progress, and might have made greater had the peat been made less moist.

Elm, on peat-moss, upwards of forty years old, has a diameter of 9 inches, at 18 inches from the ground, and a height of 30 feet.

On other soil, of a clayey nature, it has a diameter of 1 foot, at 18 inches from the ground, and a height of 25 feet.

The number of trees of this species that were planted appear to have been very limited, and in some soils soon show signs of decay where the ground is exhausted; but when fresh food is supplied them they will grow vigorously, producing broad healthy leaves.

Oak—Quercus robur. A sprinkling of oak plants was also put in when the moss was planted. They are not all grown alike well, as is the case in most plantations of oak. Some of them are good healthy trees, where they have had room to grow; others that have been much shaded, or crowded by others of more rapid growth, have not done so well. Nurses sometimes injure trees they are intended to shelter, when they are not removed in time; but as the oak is still a tree that will be long esteemed in this country, every encouragement ought to be given to its cultivation.

Common oak, upwards of forty years old, on peat-moss, has a diameter of 1 foot 4 inches, at 18 inches from the ground, and a height of 35 feet.

On clayey soil it has a diameter of 1 foot 1 inch, at 18 inches from the ground, and a height of 25 feet.

These tables show at one view the progress of the trees on peat-moss and other soil, planted upwards of forty years, and growing in the same locality.

On Peat-Moss.

	Scotch Fir		Larch.		Spruce.		Alder.		Birch.		Elm.		Oak.	
	Feet.	In.	Feet.	In.	Feet.	In.	Feet.	In	Feet.	In.	Feet.	In.	Feet.	In.
Diameter . .	1	5	1	9	1	7	1	0	1	3	0	9	1	4
Height... ...	45	0	50	0	45	0	35	0	45	0	30	0	35	0

On Other Soil.

	Scotch Fir.		Larch.		Spruce.		Alder.		Birch.		Elm.		Oak.	
	Feet.	In.	Feet.	In.	Feet.	In.	Feet.	In.	Feet.	In.	Feet.	In.	Feet.	In.
Diameter.....	1	5	1	2	1	1	0	8	..	...	1	0	1	1
Height........	45	0	50	0	45	0	35	0	...	...	25	0	35	0

A small portion of the peat is lower than the general body of the moss, the surface having been removed at one time for various purposes; but, about thirty years ago, it was planted, along with the ground adjoining, with various kinds of trees; and on the peat, the larch was the principal species planted. The moss is nearly a dead level, but a number of open drains were made, leading to the main drain. The surface of this part of the moss has a different appearance altogether from the larger portion. Instead of the heath, bilberry, and plants of a similar nature, it is almost covered with grass of various species, so that few of the plants that grow on the larger portion do not grow on the other. The trees were put in about 4 feet apart, and thinned out gradually afterwards. At present they stand about 8 and 10 feet apart. If they had stood a little wider apart, there might have been less dead wood on the trees, especially on the larch; but, when allowed to grow somewhat close together, they soon become useful for pit-wood—a use to which much of it has been put.

There are plenty of trees growing on other soil of the same age as those on the peat, to compare together. The soil is rather of a better quality than that planted forty years ago, when the larger portion of the peat-moss was planted, but the subsoil is nearly of the same nature.

Scotch fir, on peat, planted thirty years ago, has a diameter of 1 foot, at 18 inches from the ground, and a height of 30 feet.

On other soil, at the same age, it has a diameter of 1 foot, and a height of 25 feet.

Larch, on peat-moss, planted thirty years ago, has a diameter of 1 foot 2 inches, and a height of 40 feet.

On other soil, at the same age, it has a diameter of 1 foot, and a height of 35 feet.

Spruce on peat-moss, planted thirty years ago, has a diameter of 1 foot 3 inches, and a height of 35 feet.

On other soil, at the same age, it has a diameter of 1 foot, and a height of 30 feet.

Ash, on peat-moss, planted thirty years ago, has a diameter of 6 inches, and a height of 30 feet.

On other soil, at the same age, it has a diameter of 1 foot 1 inch, and a height of 35 feet.

Elm, on peat-moss, planted thirty years ago, has a diameter of 10 inches, and a height of 30 feet.

On other soil, at the same age, it has a diameter of 1 foot 3 inches, and a height of 35 feet.

Oak, on peat-moss, planted thirty years ago, has a diameter of 8 inches, and a height of 30 feet.

On other soil, at the same age, it has a diameter of 1 foot, and a height of 25 feet.

Plane, on peat-moss, planted thirty years ago, has a diameter of 5 inches, and a height of 20 feet.

On other soil, at the same age, it has a diameter of 10 inches, and a height of 30 feet.

Another portion of the peat-moss had its surface still more reduced than that portion which was planted thirty years ago. It was planted twelve years since, and other places adjoining were planted about the same time. The surface of the peat was well broken up, and pretty well decomposed, only rather moist, there being not many drains in it. The firs appear to thrive best in it, while the hardwood is not so healthy nor so high as those of the same age planted on other soil.

The following are the average heights of the trees in the different soils, planted about twelve years ago:—

Scotch Fir,	on moss,	height 18 feet.		Oak,	on other soil,	height 16 feet.	
Do.	on other soil,	do. 20 do.		Elm,	on moss,	do. 10 do.	
Larch,	on moss,	do. 20 do.		Do.	on other soil,	do. 12 do.	
Do.	on other soil,	do. 20 do.		Ash,	on moss,	do. 12 do.	
Spruce,	on moss,	do. 22 do.		Do.	on other soil,	do. 12 do.	
Do.	on other soil,	do. 22 do.		Plane,	on moss,	do. 14 do.	
Oak,	on moss,	do. 10 do.		Do.	on other soil,	do. 14 do.	

In this plantation the young trees were planted about 4 feet apart, the hardwood being about 12 feet apart in the pits, and the firs filling up the intervals in slits. The trees at present are in a healthy state, but, like all other plantations, some trees are making greater progress than others. Much depends upon the manner in which trees are treated after they are planted. If left to struggle with one another for light and air, in a crowded state, they will soon injure one another, to such an extent as to be rendered helpless for life; but where timely thinning is practised, and no more left than the soil can well support, woods would have a very different appearance from what they generally present. This young plantation receives an annual thinning, and the more it is thinned the stronger it grows.

From what we have related, there seems little doubt but that trees will grow well in any variety of peat, if the water be drawn off in sufficient quantity to prevent its injuring the roots. It seldom happens that such an opportunity as the present occurs for observing the progress of trees in different varieties of peat; and although the peat-moss here is on a small scale, compared with the extensive tracts of peat-moss in Scotland, it is sufficiently large to show what may be done with peat-moss by planting.

PROCEEDINGS IN THE LABORATORY.

By Professor Anderson, M.D., Chemist to the Highland and Agricultural Society.

ON THE NUTRITIVE VALUE OF DIFFERENT SUBSTANCES EMPLOYED AS FOOD FOR CATTLE.

(*Continued from* p. 456.)

The analyses of linseed-cake which terminate the portion of this paper published in last number of the Transactions, show an average nearly identical with those of Mr Way, as far as the amount of nitrogen is concerned; but they give a larger proportion of oil than any of those examined by him, except the English, which in this respect has a marked superiority. The average, however, is here brought up by two samples, which surpass even English cake in the quantity of oil they contain. That from Wolgast is remarkably high, and I would direct particular attention to it, because it was given me as a remarkably fine and valuable sample; and I am desirous of pointing out that, commercially, a sample of cake is valued for the percentage of oil,

and not of nitrogen, which it contains—this sample being very poor in the latter. We shall see reason, in a subsequent part of this paper, to doubt whether this is a perfectly fair method of estimating its value.

In calculating the results of the analyses of other substances, I have found it more convenient for purposes of comparison, to state them in a manner different from that which is done in the preceding analyses, and to calculate, from the amount of nitrogen, the quantity of protein compounds which it represents; and when this is done, the average composition of linseed cake is represented as follows:—

Water,	12.44
Oil,	12.79
Albuminous compounds,	27.69
Ash,	6.13
Other constituents,	40.95
	100.00
Nitrogen,	4.33
Silica,	1.05
Phosphates,	2.73
Phosphoric acid,	0.55

I have as yet made only a single analysis of linseed; but it may serve as a fair average, as, in all its valuable constituents, it comes very close to the results obtained by Mr Way. The sample was one sold expressly for feeding purposes.

LINSEED.

Water,	7.50
Oil,	34.00
Albuminous compounds,	24.44
Ash,	3.33
Other constituents,	30.73
	100.00
Nitrogen,	3.85
Phosphates,	2.03
Phosphoric acid,	0.12

RAPE-CAKE.

The use of rape-cake, either alone, or mixed with linseed-cake, has, within the last few years, extended considerably in this district. So far as I know, there are only two published analyses by Mr Way, and of specimens of cake the source of which was unknown, and has now attained considerable importance. I have paid some attention to the determination of its average composition, and the results of the analyses given below would indicate for it a percentage of oil little inferior to that of linseed cake, and a decided superiority in the nitrogenous or albuminous constituents:—

RAPE-CAKE.

	1. Stettin.	2. Danzig.	3. Bohemian.	4. Unknown.	Average.
Water,	12.27	10.11	8.64	11.72	10.68
Oil,	10.00	9.68	14.32	10.42	11.10
Albuminous compounds,	30.19	29.55	27.69	30.70	29.53
Ash,	6.77	7.67	6.69	9.05	7.79
Other constituents,	40.77	42.99	42.66	38.01	40.90
	100.00	100.00	100.00	100.00	100.00
Nitrogen,	4.74	4.64	4.33	4.82	4.38
Silica,	0.73	2.15	...	0.68	1.18
Phosphates,	3.88	4.21	3.73	3.66	3.87
Phosphoric acid,	0.48	0.58	0.44	0.07	0.39

These analyses place rape-cake perfectly on a level with linseed-cake, as far as feeding properties go. It must be remembered, however, that it has one disadvantage, which somewhat limits its use; its taste is peculiar, and at first generally repugnant to the animals to which it is given; and it may therefore not unfrequently happen, that the actual results of feeding with it may not be so good as with other sorts of food for which they may have a natural liking. There is no doubt, however, that very good results have been obtained from its use, and analysis places it high in the list of feeding substances.

The analyses which now follow I shall give without any comment, and shall reserve my observations for the conclusion of the paper. They embrace several substances seldom employed as food, the supply of them being limited and uncertain; but it is not impossible that, when their value is more fully determined, they may be imported in larger quantity than they now are.

The substances are arranged in the order of the amounts of oil and albuminous substances which they contain; and where no reference is made to oil, it was either absent altogether, or the quantity so small that it could not be accurately determined.

No. 12.—*Poppy Cake.*

Water,	11.63
Oil,	5.75
Albuminous compounds,	31.46
Ash,	12.98
Other constituents,	38.18
	100.00
Nitrogen,	4.94
Silica,	3.36
Phosphates,	6.93
Phosphoric acid,	3.27

No. 13.—*Crambolina Cake.*

Water,	11.62
Oil,	9.50
Albuminous compounds,	28.79
Ash,	7.85
Other constituents,	42.24
	100.00
Nitrogen,	4.52
Silica,	2.14
Phosphates,	3.08
Phosphoric acid,	0.08

No. 14.—*Cotton-Seed Cake.*

Water,	11.19
Oil,	9.08
Albuminous compounds,	25.16
Ash,	5.64
Other constituents,	48.93
	100.00
Nitrogen,	3.95
Silica,	1.32
Phosphates,	2.19
Phosphoric acid,	0.15

No. 15.—*Beans.—65 lb. per bushel—35s. per quarter—£7, 10s. per ton.*

Water,	15.84
Oil,	1.59
Albuminous compounds,	24.70
Ash,	3.36
Other constituents,	54.51
	100.00
Nitrogen,	3.89
Phosphates,	0.49
Phosphoric acid,	0.46

No. 16.—*Field Beans.*
(Home growth.)

Water,	12.56
Oil,	1.58
Albuminous compounds,	27.05
Ash,	3.12
Other constituents,	55.69
	100.00
Nitrogen,	4.26
Phosphates,	0.84
Phosphoric acid,	0.88

No. 17.—*Foreign Beans.*

Water,	12.21
Oil,	1.51
Albuminous compounds,	23.49
Ash,	3.14
Other constituents,	59.65
	100.00
Nitrogen,	3.70
Phosphates,	0.89
Phosporic acid,	0.63

No. 18.—*Hopetoun Tares.*
(Home growth, crop 1849.)

Water,	16.09
Oil,	1.49
Albuminous compounds,	28.32
Ash,	1.49
Other constituents,	52.61
	100.00
Nitrogen,	4.46
Phosphates,	0.86
Phosphoric acid,	0.48

No. 19.—*Scotch Tares.*
(Crop 1849.)

Water,	8.99
Oil,	1.30
Albuminous compounds,	28.57
Ash,	2.50
Other constituents,	58.64
	100.00
Nitrogen,	4.50
Phosphates,	0.90
Phosphoric acid,	0.36

No. 20.—*Spring Tares.*
(Foreign growth.)

Water,	12.13
Oil,	1.26
Albuminous compounds,	26.54
Ash,	2.35
Other constituents,	57.72
	100.00
Nitrogen,	4.18
Phosphates,	0.89
Phosphoric acid,	0.29

No. 21.—*Winter Tares.*
(Foreign growth.)

Water,	15.80
Oil,	1.59
Albuminous compounds,	26.73
Ash,	2.84
Other constituents,	53.04
	100.00
Nitrogen,	4.21
Phosphates,	0.98
Phosphoric acid,	0.46

No. 22.—*Grey Field-Peas.*

Water,	11.94
Oil,	3.30
Albuminous compounds,	24.25
Ash,	2.52
Other constituents,	57.99
	100.00
Nitrogen	3.82
Phosphates,	0.87
Phosphoric acid,	0.16

No. 23.—*Maple Peas.*

Water,	13.63
Oil,	1.72
Albuminous compounds,	19.43
Ash,	2.04
Other constituents,	63.18
	100.00
Nitrogen,	3.06
Phosphates,	0.60
Phosphoric acid,	0.25

No. 24.—*Kidney Beans.*

Water,	13.00
Oil,	1.22
Albuminous compounds,	20.06
Ash,	3.56
Other constituents,	62.16
	100.00
Nitrogen,	3.16
Phosphates,	0.95
Phosphoric acid,	0.40

No. 25.—*Large Lentils, grown near Queensferry, by M. Guillerez.*

Water,	12.51
Oil,	1.78
Albuminous compounds,	24.25
Ash,	2.68
Other constituents,	58.78
	100.00
Nitrogen,	3.82
Phosphates,	0.66
Phosphoric acid,	0.70

No. 26.—*Lentils,* (foreign.)

Water,	12.31
Oil,	1.51
Albuminous compounds,	24.57
Ash,	2.79
Other constituents,	58.82
	100.00
Nitrogen,	3.87
Phosphates,	0.60
Phosphoric acid,	0.51

No. 27.—*Sunflower Seed.*

Water,	10.70
Oil,	20.98
Albuminous compounds,	12.70
Ash,	2.64
Other Constituents,	52.98
	100.00
Nitrogen,	2.00
Phosphates,	1.48
Phosphoric acid,	traces

No. 28.—*Guinea Corn.*

Water,	13.16
Oil,	3.46
Albuminous compounds,	9.27
Ash,	1.73
Other constituents,	72.38
	100.00
Nitrogen,	1.46
Phosphates,	0.71
Phosphoric acid,	0.14

No. 29.—*Wheat.—64 lb. per bushel—40s. per quarter—£8, 15s. per ton.*

Water,	16.88
Oil,	1.99
Albuminous compounds,	9.01
Ash,	1.57
Other constituents,	70.55
	100.00
Nitrogen,	1.42
Phosphates,	0.53
Phosphoric acid,	0.28

No. 30.—*Oats.—43 lb. per bushel—20s. per quarter—£6, 10s. per ton.*

Water,	12.66
Oil,	6.12
Albuminous compounds,	10.16
Ash,	2.66
Other constituents,	68.40
	100.00
Nitrogen	1.60
Phosphates,	0.65
Phosphoric acid,	0.01

No. 31.—*Barley.—56 lb. per bushel—26s. per quarter—£6, 10s. per ton.*

Water,	15.97
Oil,	1.88
Albuminous compounds,	7.74
Ash,	2.14
Other constituents,	72.27
	100.00
Nitrogen,	1.22
Phosphates,	0.56
Phosphoric acid,	0.35

No. 32.—*Buckwheat.*

Water,	14.69
Oil,	2 69
Albuminous compounds,	9.84
Ash,	1.62
Other constituents,	71.16
	100.00
Nitrogen,	1.55
Phosphates,	0.91
Phosphoric acid,	traces

No. 33.—*Red Wheat Straw.*

Water,	13.34
Albuminous compounds,	1.50
Ash,	6.80
Other constituents,	78.36
	100.00
Nitrogen,	0.22
Phosphates,	0.06

No. 34.—*White Wheat Straw.*

Water,	11.23
Albuminous compounds,	1.37
Ash,	7.98
Other constituents,	79.42
	100.00
Nitrogen,	0.20
Phosphates,	0.14

No. 35.—*Early Angus Oat Straw.*

Water,	12.06
Albuminous compounds,	1.50
Ash,	4.81
Other constituents,	81.63
	100.00
Nitrogen,	0.22
Phosphates,	0.08

No. 36.—*Chevalier Barley Straw.*

Water,	10.89
Albuminous compounds,	1.90
Ash,	6.24
Other constituents,	80.97
	100.00
Nitrogen,	0.30
Phosphates,	0.24

No. 37.—*Common Scotch Bean Straw.*

Water,	19.23
Albuminous compounds,	8.25
Ash,	6.67
Other constituents,	65.85
	100.00
Nitrogen,	1.30
Phosphates,	1.03

Winter Bean Straw.

	No. 38. Straw.	No. 39. Pods.	No. 40. Both together.
Water,	20.90	22.01	20.40
Albuminous compounds,	6.79	10.35	5.71
Ash,	6.35	6.22	6.39
Other constituents,	65.96	61.42	67.50
	100.00	100.00	100.00
Nitrogen,	1.07	1.63	0.90
Phosphates,	1.35	0.68	0.39

Hay.

	No. 41. New.	No. 42. Year old.
Water,	16.54	13.13
Albuminous compounds,	6.16	4.00
Ash,	7.41	5.26
Other constituents,	69.89	77.61
	100.00	100.00
Nitrogen,	0.97	0.63
Phosphates,	0.20	0.52

No. 43.—*Clover Hay.—Second Crop.*

Water,	16.84
Albuminous compounds,	13.52
Ash,	5.21
Other constituents,	64.43
	100.00
Nitrogen,	2.13
Phosphates,	0.86

The foregoing analyses, as will be at once seen, embrace a large proportion of the substances in common use as food for cattle, and, if taken in conjunction with those of the turnip, and of different sorts of clover which have been published in previous numbers of the Transactions, may be considered as giving a pretty full idea of the values of these substances. In some respects they are, no doubt, deficient: I have endeavoured, however, to make the series as complete, and to obtain as many substances, as possible; but, from the limited cultivation of many of them in Scotland, I have not yet succeeded in obtaining all in a state fitted for analysis. I shall use such means as are in my power to supply these blanks, and when the analyses are more numerous and complete, it is my intention to draw up an extended series of tables, by means of which the relative nutrient values of the different substances may be estimated. Meanwhile, without attempting the minute discussion of all that is to be considered in forming a proper estimate of these values, I shall here touch shortly on the most prominently important circumstances, reserving all details until I am in a condition to supply results founded on more extensive experiments.

It may be stated, generally, that the food of all animals must consist of a proper intermixture of substances capable of supplying nitrogen, carbon, and inorganic substances, of which phosphoric acid is the most important. The first of these is required for the

production of the albuminous or muscular constituents of the animal frame; the second, for that of fat, and for the support of the respiratory process; the third, for the production of bone, &c. The proportion of these substances required for the nutrition of the animal, is not, however, invariable, but depends partly on age, and partly on the circumstances in which it is placed. So long as an animal has not reached maturity, a large quantity of the elements of bone is required, as well as of all the other substances, which must be consumed in increasing the size of the animal. But when it has arrived at its full size, it no longer requires those abundant supplies of phosphates which are necessary for the growing animal, while the food becomes such as suffices to sustain those great physiological changes which are proceeding in the living body; and for all this nature has beautifully provided, for in the milk she has prepared a food peculiarly rich in phosphates, and plentifully supplied with all the other elements which the young animal requires. On the other hand, when the stage of existence during which a rapid increase in size takes place, has been passed, the animal comes to foods which supply no more nutriment than is consumed in the daily waste of the body. The object of the feeder, however, is not merely to sustain the animal in its normal condition, but to produce what may be considered an abnormal deposition of fat and muscular fibre. To effect this, he must supply, in increased proportion, the elements required to form those constituents of the frame, and long experience has enabled the farmer to ascertain, with some degree of success, the method in which this is to be done; but the information has been obtained with much labour, and no doubt with much loss. Though indubitably imperfect, this information served its purpose under the old system of farming; but as things advanced, and new substances were employed, the economy of food became more important, and the imperfections of our previous knowledge forced themselves home to the practical man. The object now to be held in view in feeding cattle is, so to apportion to them different sorts of food as to produce the greatest possible effect in increasing the weight of flesh and of fat. To effect this, the fundamental point is, first, to ascertain the constituents to which the formation of these portions of the body is due, and this the researches of chemists and physiologists have long since established, though it is only lately that the agriculturist has taken advantage of them. They have shown that the production of muscular fibre or flesh is proportionate to the albuminous constituents the food contains, and that of fat to the carbonaceous constituents, though the latter is dependent not only on the quantity of these substances consumed, but also on the proportion of them which is employed for sustaining the respiratory process, which is variable. The albuminous constituents of animals are identical with those of plants;

and in the increase of these, all that happens is a simple deposition of them in the tissues of the animal; but of the carbonaceous or fat-producing foods, there are two great classes—the fats and the saccharine substances. The fatty matters of plants are identical with those of animals, and it was long supposed that they were the sole and only source of the fat of animals; but more recent investigations have shown that a part of them, at least, may be obtained by a peculiar decomposition of the saccharine matters. This opinion, long a matter of dispute among scientific men, may now be considered as set at rest; and it is admitted on all hands that the fats of animals may be produced from both classes of carbonaceous compounds; but there can be little doubt that, when a sufficiency of fatty matters is supplied in the food, the fattening of an animal is more likely to be due to the simple accumulation of that fat in its system, than to the production of it from other substances. For this reason, the proportion of fat or oil which a food contains must always be a matter of much importance, and must form an element in the estimation of the value of all kinds of food.

The great points in the determination of the value of different sorts of food are, then, the albuminous matters and fats. But we are still greatly—nay, altogether in the dark as to the *relative* values of these *two classes of substances;* and a very slight consideration of the matter will show that they cannot be estimated by chemical means. Their *quantities* are estimated in the previous analyses; and so long as we adhere to one element, we can, of course, easily determine the relative values of the substances in relation to this one element; but we cannot ascertain chemically the nutritive value due to each constituent, when, as is commonly the case, two or more of them occur in the same substance, so as to estimate the total nutritive value of the food. This must be done by experiment upon animals, and I know nothing which would be so great a boon to agriculture as the performance of such experiments. In the mean time, I append to this paper two tables, the first giving the relative quantities of the albuminous compounds; the other, that of the oil in the foods hitherto examined in my laboratory, which may be used with advantage in determining the nutritive value of foods, to a certain extent. The principle on which I think they ought to be employed is, to ascertain from them what foods are richest in either substance, and, in feeding, to apportion the two together so that there shall be no excess of either constituent. What the best proportion of albuminous to fatty matters is, we can at present only guess, and it must be determined by experiment; but experience has shown that, while great benefits are derived from the uses of those substances which are rich in albuminous and fatty matters, it will not do to trust too exclusively to these. There must be a sufficient supply of all the other

constituents, including especially the phosphates; and though no foods are devoid of these, some present a very small percentage of certain of them.

A very slight inspection of the tables with which this paper terminates, will serve to show how they may be employed to estimate the values of the different foods, and to suggest the proportions in which they should be used together. Suppose, for instance, a farmer had been giving his cattle 150 lb. of turnips per day, and, for some reason, was desirous of husbanding them, and of giving only 100 lb. to each, and wished to know what substance, and in what proportion, he ought to employ instead, he would first inspect the table, and would decide, probably, on the employment of oil-cake, which is found to stand high in both the tables. Suppose he had selected poppy cake, and specially with reference to the amount of albuminous matters which it contains, then the quantity which he ought to employ to replace 50 lb. of turnips is found by the following proportion between the quantities of albuminous substances in both—

31.45 : 1.27 50 lb. : 2.01 lb.

It appears from this that 2.01, or almost exactly 2 lb., would contain the same quantity of albuminous constituents as 50 lb. of turnips. It would not be prudent, however, to trust to exactly 2 lb. of poppy cake as the equivalent of 50 lb. of turnip; for, in the former, the total quantity of solid matters will amount only to 1 lb. 12 oz., while, in 50 lb. of turnips, there will be about 3 lb.; and the excess in weight of the latter is due to its containing a larger quantity of the saccharine class of constituents, which is small in the poppy cake; and to make up for this, a somewhat larger quantity ought to be employed.

By a similar calculation to that given above, we find that 50 lb. of turnips correspond to 2.29 lb. of linseed cake. If we reckon turnips at 8s. per ton, then 50 lb. will cost about 2¼d.; while at present, when linseed cake sells at about £10 per ton, 2.29 lb. will cost between 2½d. and 2¾d., and is consequently, at present prices, a dearer food than turnips. It is also much dearer than tares and beans, and some of the other substances mentioned in the table.

I should have wished to have embraced in the analyses I have performed, those of many of our root crops, some of which I believe to be deserving of more attention on the part of our farmers than they have yet received; but these and various other analyses I must defer to a future opportunity.

I.—TABLE, showing the Proportion of ALBUMINOUS MATTERS contained in 100 parts of different substances employed as FOOD for CATTLE.

Poppy cake,	31.46	Oats,	10.16
Rape cake,	29.53	Buckwheat,	9.84
Crambolina cake,	28.79	Guinea corn,	9.27
Common Scotch tares,	28.57	Wheat,	9.01
Hopetoun tares,	28.32	Common Scotch bean straw,	8.25
Linseed cake,	27.69	Barley,	7.74
Field beans,	27.05	Hay, (new,)	6.16
Winter tares, (foreign,)	26.73	Winter bean straw,	5.71
Spring tares, (ditto,)	26.54	Hay, (old,)	4.00
Cotton seed cake,	25.16	Crimson clover, (T. incarnation,)	3.30
Beans, (65 lb. per bushel,)	24.70	Yellow clover,	3.26
Linseed,	24.44	Lucerne,	3.11
Lentils,	24.57	Cow grass, (T. medium,)	2.75
Large lentils, (Scotch growth,)	24.25	Red clover,	2.59
Grey peas,	24.25	Chevalier barley straw,	1.90
Foreign beans,	23.49	Early Angus oat straw,	1.50
Kidney beans,	20.06	Red wheat straw,	1.50
Maple peas,	19.43	White wheat straw,	1.37
Clover hay, (second crop,)	13.52	Turnip,	1.27
Sunflower seed,	12.70		

II.—TABLE, showing the Proportion of OIL contained in 100 parts of the different substances used as FOOD for CATTLE.

[Where the substance is not mentioned, it either contains no oil, or so little that it cannot be accurately determined.]

Linseed,	34.00	Lentils, (Scotch growth,)	1.79
Sunflower seed,	29.98	Maple peas,	1.72
Linseed cake,	12.79	Winter tares, (foreign,)	1.58
Rape cake,	11.10	Beans, (65 lb. per bushel,)	1.59
Crambolina cake,	9.50	Field beans,	1.58
Cotton-seed cake,	9.08	Foreign beans,	1.51
Oats,	6.12	Foreign lentils,	1.51
Poppy-cake,	5.75	Hopetoun tares,	1.49
Guinea corn,	3.46	Common Scotch tares,	1.30
Grey peas,	3.30	Spring tares, (foreign,)	1.26
Buckwheat,	2.69	Kidney beans,	1.22
Wheat,	1.99	Turnip,	0.20
Barley,	818		

ON THE USE OF THE GRUBBER.

By Mr JOHN WILSON, Edington Mains, Berwickshire.

[Premium—The Gold Medal.]

IN the following report on the advantages of the grubber as a substitute for the plough, I shall do little more than narrate my own experience for the past three years. Previous to this period, I had been in the habit of using Finlayson's harrow—the form of grubber then most in repute—as an auxiliary to the ordinary tillage implements. But this grubber, however excellent as compared with its predecessors or contemporaries, is too severe in draught, too heavy and costly, for the full benefits of tillage by grubbing to be realised through its use. Towards the close of 1849, the perusal of General Beatson's treatise,* with other concurring circumstances, induced me to look out for some more simple and efficient implement of this class than I had yet met with. On communicating my wishes to Messrs Scoular and Company, agricultural-implement makers in Haddington, I was made aware for the first time that such an implement as I desired had, two or three years previously, been introduced in East Lothian by Mr Alexander Howden, Traprain, (hence known as the "Traprain" Grubber,) and that, more recently, they had themselves brought out what they considered an improvement upon it. In February 1850, I visited Messrs Scoular's factory, and, after examining both these forms of light grubber, purchased five of the kind introduced by themselves. Subsequent to this, a correspondence in the *North British Agriculturist* newspaper made known to its readers that the Traprain grubber was the invention of Mr John Tennant, at Shields, near Monkton in Ayrshire. In the spring of 1851, Mr Tennant, having introduced a considerable improvement in the form of the tines of his grubber, and also a contrivance for excluding sand from the axle of its wheel, and retaining the oil, had his implement registered. Drawings and a description of the grubber, as thus improved, appeared in the *Practical Mechanics' Journal* for 1st July 1851, and from thence were copied into the leading agricultural journals. The implement has been extensively sold, and is now to be met with in all parts of the kingdom. Before this description was published, I had procured two Tennant's grubbers, in the form of it then in use in East Lothian, and also another from Messrs Scoular and Company, which they call the "triangle" grubber, the whole of which I have since had in stated use. The implements now referred to have their main features in common, and are distinguished from all others of their class by their extreme lightness, cheapness, simplicity of construction, and easy draught.

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* *A New System of Cultivation, &c.* By Major-General ALEXANDER BEATSON. 2d Edition. London, 1821.

Their weight is about 2 cwt.; their price, from 55s. to 65s.;* their draught thoroughly under the power of even a light pair of horses; the width covered by one of them, when at work, is 3 feet; and the space gone over by it, in a given time, somewhat more than four times as much as can be done by a plough. Both the implements now referred to are so excellent that it is hard to decide betwixt them. Each has, in certain respects, some advantage over its rival; but the balance of excellence is, upon the whole, in favour of Tennant's. So much for the implements themselves, and now for their uses.

My first trial of them was made in March 1850, upon a field of light loam, which had borne a crop of turnips the previous year. These had been consumed by sheep early in autumn, and the land immediately thereafter ridged up; so that, after exposure to the frosts and rains of an entire winter, I found it too much weathered to admit of the seed-corn being properly covered by mere harrowing. After sowing barley broadcast, it was accordingly stirred by a single turn of these grubbers, and then harrowed. By this means the seed was covered to a wish, such weeds as had sprung up were destroyed, and the surface-soil nicely pulverised. The space gone over in a day by each grubber was about 4 acres. As the sequel will show, I should now treat such a case somewhat differently. A good crop of barley was, however, obtained, and at the time I had every reason for being satisfied with this first trial of light grubbers.

Shortly after this, they were set to work upon a portion of my fallow-break. The piece of land in question had been planted with potatoes in the preceding rotation, and as these were cut off early in the season by the prevailing disease, the weeds had got ahead, and the land was left very foul. By grubbing it twice, in opposite directions, the weeds were brought to the surface, and removed with far less labour, and in much shorter time, than I ever could do before. Had I commenced the cleaning process by cross-ploughing, according to former usage, the roots of the couch-grass would have been cut into innumerable fragments, and mixed through the soil, whereas these grubbers brought them to the surface unbroken. After being freed from adhering soil by the frequent use of the common harrows and one-horse rollers, the weeds were collected by means of common hay-rakes. I ascertained at that time that a field-worker can clear about *five* times more space in a day by raking than by hand-picking, and make quite as good work. My next experiment in grubbing was upon a piece of light, dry, muiry soil, on a sandy subsoil, on which a turnip crop had just been consumed by sheep. This field I had resolved to sow with grass-seeds, without a grain crop. Part of it had already been ploughed up in

* Owing to the recent advance in the price of iron, about 15s. has been added to that of each grubber.

ridges and sown; but it occurred to me to try whether a sufficient tilth could not be obtained on the remainder without using the plough at all. Taking advantage, therefore, of a moderate rain, by which the soil previously trodden hard by the sheep was somewhat softened, I set these grubbers to work, and, by going over it twice, my purpose was effectually accomplished. The soil was stirred as deeply as was necessary, the manure was kept near the surface where the grasses would get most good from it, and a fine mould, most suitable for the germinating of small seeds, was easily obtained. The seeds were then sown, covered in by means of Crosskill's roller, and the whole work accomplished in less than half the time that would have been required had it been ploughed. This field has now been in pasture for three seasons, and has grazed so unusually well, as to convince me of the propriety—at least as regards similar soils—of this plan of sowing grass-seeds without a grain crop. Although the whole field has done well, I have yet observed, that on that part of it which was grubbed the herbage has maintained a deeper green, and has been preferred by the stock to that on the ploughed portion.

Part of my turnip-break for that year (1850) consisted of a low-lying field of peaty soil, resting on a subsoil of mingled sand, clay, and quartz gravel, drained with tile-drains 3 feet deep, and from 15 to 30 feet apart, according to the varying degrees of wetness, the whole having been brought under tillage for the first time about ten years before. It had carried a crop of oats in 1849 after two years' grass, had been ploughed up after the removal of the crop, and so lay until about the beginning of May following. It was then worked by these grubbers, and about three-fourths of it, without any previous ploughing, drilled up and sown with turnips. The remainder of the field, not being so clean, got one ploughing; and although the whole was sown under (apparent) equally favourable conditions, the crop on this ploughed portion was manifestly inferior to that on the remainder, which was prepared by grubbing only.

Later in the same season, I found great advantage from using these implements in working a field of strong clay-loam, with a subsoil of clay-marl. Half of this field is drained, and the other not, the drains being 2½ feet deep, 30 feet apart, and filled with clean river-gravel, and tiles in the main drains. It was in process of bare-fallowing; and from the size and hardness of the clods I was afraid, before trial, that here these light implements would prove of little use. In this, however, I was agreeably disappointed, for by stirring it with them repeatedly during a period of hot, parching weather, the couch-grass and other weeds were so effectually destroyed that it was found unnecessary to gather them off. In the autumn of the same year, I used them again in preparing a piece of land for wheat after potatoes. This was a deep friable loam, resting on freestone, and drained with tile-drains 2½ feet deep

and 30 apart. After the potatoes were harvested, and the haulm raked off, the land was twice grubbed and harrowed, and the wheat drilled in immediately without any ploughing. Alongside this potato-land lay a piece of bean-stubble, three ridges of which were, for experiment, treated in precisely the same way as the potato-land, and the rest of it ploughed up in ridges, and sown with wheat broadcast. The whole proved an excellent crop, that after the potatoes being the bulkiest, and that upon the three ridges of bean-stubble quite as good as on the ploughed part.

About the same time I made my first trial with these grubbers in autumn-cleaning an oat-stubble intended to bear turnips the following season. It is a field of light sandy loam, with sandy subsoil, and most of it naturally dry. It was first ploughed with a light furrow, and then repeatedly grubbed, harrowed, and rolled, after which the weeds were raked together and carted off, and the land again ploughed more deeply than before, and so left until the following April. My turnip-break for 1851 consisted of 210 acres, of which 130 (including the field autumn-cleaned) is either light sandy loam, or black, light, moory soil on a sandy subsoil, the wetest parts having been drained with tile and sole, 30 inches deep and 30 feet apart. The remaining 80 acres is strong brown loam, for the most part upon a pervious subsoil over freestone rock, but interspersed with bands and knolls, in which clay predominates, both in soil and subsoil. About the half of this has been drained in the manner last described; the remainder is undrained, and for the most part tolerably dry. Nearly the whole had, the previous year, carried a crop of oats after lea; and in autumn the whole had been ploughed with a good deep furrow. By the repeated use of grubbers, harrows, and light rollers, the whole of these 130 acres were cleaned, brought to a fine tilth, and at the proper season drilled up and sown with turnips, without any spring ploughing whatever, except in the case of some headlands that had been consolidated by carting. In two fields, portions of the crop suffered much from "fingers and toes," but the remainder was a remarkably abundant crop. It was inspected and much admired by several practical farmers, who could detect no deficiency in the cleanness or condition of the soil, and were much surprised to find that the spring tillage had been effected by grubbing only. Of the 80 acres of strong soil, 10 were dunged on the stubble before receiving the autumn ploughing. Early in May this piece of land, after being well stirred by the grubbers, was drilled up and sown with swedes. A good braird ensued, but, a few days after, the young plants were so completely destroyed by the turnip-flea that a second sowing had to be resorted to. A tolerably good crop was ultimately obtained; but still this accident so interfered with the experiment as to hinder satisfactory conclusions being drawn from it. After the removal of the turnip crop, this portion of the field did certainly plough up less kindly than the remainder; but the

whole field has since produced a good crop of wheat, and is now covered with a close plant of young clover. The remainder of the turnip-break on this stronger division of the farm received at least one, and some of it two, spring ploughings; but much valuable aid was obtained from the light grubbers, both in pulverising and cleaning it. During this season I also became aware of the value of these implements as *drill-grubbers*. To adapt them for this purpose, the outside tine on each side is removed, those on the front bar are shifted close to the beam, and the supplementary pair fixed upon the hind bar about 16 inches apart; a pair of horses are then yoked to the grubber, as thus arranged, by a main-tree long enough to admit of them walking abreast in the drills immediately to the right and left of the one that is being operated upon. By thus using an implement so much stronger than the common horse-hoe, and a pair of horses to draw it, the soil can be stirred to a great depth without any risk of the loose earth being thrown upon the tender plants, and with very little chance of any weed escaping destruction. It is peculiarly adapted for the drill-culture of beans and potatoes.

In the spring of 1852, the 130 acres of light soil, and 30 acres of the stronger soil, already referred to, were sown with barley by the process called ribbing. Profiting by the example of an enterprising farmer, Mr James Mack, at Upper Keith, I had my Tennant's grubbers fitted with a spare set of tines, upon each of which a pair of light wings, or mould-boards of plate-iron, were riveted. By lengthening the hind bar, the five tines, thus equipped, were set at 12 inches apart, and the implement, by this simple arrangement converted into a ribbing-machine, with which a man and pair of horses can rib 10 acres a-day. The land having been ploughed with a light furrow, and lain until it was mellowed by the weather, was first levelled by a double turn of the harrows; then followed the ribbing-machine; over the ribbed surface the barley was immediately sown broadcast, and covered in by a single turn of the harrows. The barley crop being now reaped, I can report most favourably of this mode of sowing. It seems to combine the good qualities both of drilling and broadcasting. There is economy of seed, and leaving of open spaces for the admission of light and air to the grain crop, and intermingled clovers and grasses, as in drilling; with the deeper seed-bed, and less crowded position of the plants, as in broadcasting.

The success obtained in a former year in sowing grass-seeds after turnips without ploughing, as already narrated, induced me to make a further experiment this year on about 20 acres of this light land, from which the turnip crop was latest in being consumed. It was the middle of April before the sheep-fold was finally removed from this portion. The drought being then intense, it was obviously of importance to get the soil pulverised, and the seed deposited, with as little loss of moisture as possible. It was ac-

cordingly stirred by the grubbers lengthwise and across, and rolled betwixt the grubbings, at once to break the crust and to retain the sap. After the second grubbing, and some harrowing and rolling, the ribbing implement was set to work, and the barley sown as already described. The barley thus treated has proved as good a crop as that on similar land adjoining, which was ploughed in ridges, while the clovers and grasses in the grubbed part are decidedly the best in the field. It will be observed that the 20 acres now referred to have thus received but *two* ploughings during an entire rotation—viz., one in breaking up from lea, and another after the removal of the oat crop following.

My fallow-break for 1852 extended to 230 acres, comprising, as in the preceding year, a larger division of light friable soil, and a lesser one of heavy loam; but in addition to these it included a field of strong clay loam, the same that has already been noticed as having been bare-fallowed in 1850. The two main divisions partake of the same general features as to soil, subsoil, drainage, and previous cropping as have already been described as pertaining to the fallow-break of 1851—with this difference only, that in two of the fields, making up the larger and lighter division, there are detached portions of tolerably strong clay-soil, extending altogether to 10 or 12 acres, and in particular several knolls, on which the soil is tough and obdurate. On about 4 acres of one of the fields of light soil, a trial was made of Mr Tennant's peculiar system of tillage, to be afterwards more fully noticed. With this exception, the whole fallow-break was ploughed in autumn in the usual manner. The lighter division of it, extending to 137 acres, has again been cleaned, pulverised, and sown with turnips, without any spring ploughing, the above 4 acres only excepted. On these, the order of the process has simply been reversed—that is, they were grubbed in autumn and ploughed in spring; whereas the general break was ploughed in autumn and grubbed in spring. This small experiment has quite confirmed the soundness of Mr Tennant's system, as I found by sowing-time that this portion of the field was the cleanest, and the turnips now growing upon it are the best. I have mentioned that in the lighter division of this year's break there are portions of clay soil. These were treated precisely like the rest of the field in which they occur. My personal experience in this mode of working such soils being not yet acquired, I was not without previous misgivings as to how they would drill up. My anxieties were, however, very soon relieved, as I this year got a better tilth and a better braird of turnips on these stubborn knolls than on any previous occasion of working them.

The division of strong loamy soil was treated for the most part in the following manner: As soon as it was dry enough in spring it received a good ploughing, after which it was left for some time untouched. It was next rolled with a heavy roller, and thereafter grubbed across the direction of the previous ploughing. By this

preliminary rolling the surface was not merely levelled, so as to admit of the more perfect action of the grubbers, but the clods, being pressed down among the loose soil, offered a firm resistance, and thus were crumbled, instead of being merely raked out and left on the surface. This operation was followed closely up by harrowing and rolling, after which the grubbers, *with their seven tines on*, were again worked at right angles to their former course, when the soil was found in prime condition for drilling. The turnip crop on the land thus treated is now a very full one.

The field of strong clay-land, already referred to, after the removal of the wheat crop, was gathered up into 15-feet ridges, with a good deep furrow, and so left until the following month of May, with the exception of one acre, on which winter tares were sown. In May, this field was stirred by the grubbers; but my plan being to sow on this field turnips which should occupy the ground until the following season, and bear a crop of seed, and as July is found an early enough seed-time for turnips so destined, nothing further was done to this piece of land until the sowing of the regular turnip crop was completed. About the middle of June it was again grubbed and harrowed, was thereby got into a fine tilth, and was about being drilled up, when a heavy fall of rain put a stop to further proceedings. By the time that it got dry again, the loosened soil was found to have set into a firm cake, and presented a very discouraging appearance. Had it been ploughed at this time, I believe that it would have turned up like cheese, and that any attempt to bring it again by such means into a state fit for turnip-sowing would have utterly failed. By waiting, however, until it was quite dry, and then working it with the grubbers, a free tilth, deep enough to admit of a sufficient drill being formed, was readily obtained; the seed was sown, and brairded freely, and the field is now covered by a beautiful crop of nice round turnips, quite forward enough for the purpose intended. The acre which had borne winter tares, after the loose haulm had been raked off, was thrice grubbed, with intervening harrowings, and was then drilled and sown with the rest of the field. Had it suited my purpose to have sown this field in May, I saw from its mellow condition that it could have been done with very little labour, and to good purpose.

So soon as the grain crop of the present year had been harvested, the grubbers were again in requisition. In the first place, 4 acres of wheat-stubble were grubbed, cleaned, ploughed up, and sown with winter tares. About the same time operations were commenced on two fields of 44 and 54 acres respectively—the former a sandy soil, naturally dry, and the latter a good deep loam, on a porous subsoil, and in which drains 3 feet deep and 30 feet apart, occupied by 2-inch pipes, have been made. Both fields were in places much infected by couch-grass. My plan in regard to them was to get the larger field cleaned as speedily as possible,

to cart on to it thereafter a quantity of summer-made dung then in the cattle-yards, and to have that spread and ploughed in before the winter; on the other, I designed to make a further and more extensive trial of Mr Tennant's system of tillage. Both fields were, in the first place, twice grubbed and well harrowed. That which it was designed to clean immediately was then grubbed a third time, and got more harrowing, after which the weeds were raked together and carted off. As some parts were still not quite clean, they got more grubbing and harrowing, and were again raked. Considerable progress has now been made in carting on the dung, and the ploughing will follow as speedily as possible. In cleaning this field I have derived much aid from the use of the Norwegian harrow. At this season it is rarely either practicable or expedient to use the roller in connection with such operations; but its place is more than supplied by the implement just named, which breaks the moist clods, and separates the weeds from the soil in a most efficient manner. It is really amusing to watch its progress over a piece of foul land which has previously been torn up by the grubbers. The tangled clots are tossed from one set of rowels to the other, are bruised and shaken to pieces, as if the implement was a sentient being, and took a malicious pleasure in persecuting these pests of the farm. The operations now detailed present at first sight a somewhat formidable amount of autumn labour; but as it is easier to execute four grubbings than one ploughing, there is in reality less extra labour than might be supposed: when it can be accomplished, it is, moreover, well expended labour. For let a stubble-field be examined in autumn, and the roots of the couch-grass will be found running near the surface, and seldom penetrating above 2 inches deep. While in this position, it is comparatively easy to tear them up and get rid of them; but let them, according to the customary practice, be buried under a good deep furrow, safe from frosts, and in the best possible position, on the first return of genial weather, for pushing their fibres through the entire mass of soil, and every farmer knows too well what it then costs him to get rid of them.

As already stated, the field of lighter soil has been twice grubbed and harrowed. If weather favours, it will probably get another grubbing, and so be left until winter is over. This I feel encouraged to do, not only by the favourable issue of the small experiment of last year, but by what I saw on Mr Tennant's own farm, which I had the pleasure of walking over in his company in February last. His published letters had so far convinced me of the soundness of his system of tillage; but it was much more satisfactory to hear it expounded by the inventor himself, and to see it exemplified in his actual practice. His whole fallow-break, at the time of my visit, was lying in the state in which I have just described my own field as now being. To the uninitiated, a fallow thus treated certainly presents at this stage a most untidy

and unpromising aspect. I found, however, that Mr Tennant's farm, as a whole, was clean and in prime condition, and yet he assured me that he had not gathered off a load of quickens for the last ten years. He explained to me that the weeds, after being brought to the surface, and there exposed during the entire winter and early spring, are so effectually killed that they can ultimately be ploughed in with safety, when they rot in the soil, and help to enrich it. By this plan, the great expense of gathering and carting off weeds is entirely avoided. It would seem, too, that when soil is pulverised *before* being exposed to the vicissitudes of wintry weather, it profits more by the action of the elements than when merely ploughed and left in compact furrow-slices. My confidence in the soundness of Mr Tennant's system has received further confirmation from what I have observed, in the course of my operations during the present autumn. I have been surprised to find that the roots of couch-grass and other weeds, when brought to the surface and freed from the soil, wither and die more rapidly at this season than they do in summer. The reason appears to be, that at the season of active growth the least morsel of a root, if covered with pulverised soil, or even in contact with it, at once pushes new fibres, regains its hold, and grows as lustily as ever; whereas if similarly exposed at the season when its vital energy is quiescent, it is unable to resist the atmospheric influences, and speedily dies. This theory appears to account satisfactorily for the success of Mr Tennant's practice.

From this narration of facts, it appears that the grubber *can* be substituted for the plough to a considerable extent, and with an important saving of time and labour. I shall not attempt to offer a money-estimate of the value of that saving; but I feel warranted by my own experience in saying that, on *friable soils*, the tillage labour of the year can be reduced to the extent of a *fifth* part merely by this substitution of implements. To the occupiers of strong *clay soils* the use of these light grubbers is of even greater importance; for by means of them they can manage to raise green crops, where hitherto a bare fallow could not be dispensed with. I have given, from my own experience, a striking illustration of this; but I can refer also to that of many farmers in East Lothian, who now produce excellent green crops on soil so tenacious, (and sometimes undrained too,) that until very recently it would have been thought foolish to attempt such a thing. Now, however, by keeping *uppermost* the soil that has been mellowed by the wintry elements; by working it only when in right condition; by then handling it quickly, as the use of these implements enables them to do; and, finally, by early sowing and early storing, they are enabled to grow large crops of turnips, to keep a large head of stock to consume them, and withal to grow as much grain as ever they did.

REPORT ON DRAINING.

By Mr James Porter, Overseer, Monymusk, Aberdeenshire.

[Premium—Ten Sovereigns.]

The utility of draining is now so well known, and so universally admitted by all intelligent agriculturists, that it appears to me unnecessary to say a word on its many advantages, further than that I believe it to be the root and origin of all good farming.

Before entering into particulars on the subject, I shall give a brief sketch of the locality and nature of the lands from which the facts of our present inquiry have been collected—viz.:

The after-mentioned operations were performed upon the estates of Monymusk, Tillyfour, and Braco, situated within the parishes of Monymusk, Oyne, Chapel of Garioch, and Inverury, and county of Aberdeen. The former estate is the property of Sir James Grant, Bart., of Monymusk, and the two latter that of Robert Grant, Esq., of Tillyfour, convener of the county, by whose directions the work was done.

These lands comprehend an area of 14,435 acres, 5700 of which are arable, about 5500 under wood, and the remaining 3235 hill pasture, water, roads, &c., lying along the south and north banks of the river Don, about 19 miles west from Aberdeen, sloping to the east and south, and sheltered from the north and west by the hills of Bennochie and Cairnwilliam, and thickly interspersed with wood. The altitude of the estates was taken by a practical engineer when surveyed in 1846, and the average height on which the draining has been done may be set down at 450 feet above the level of the sea.

Although a very considerable extent of draining had previously been done by the proprietors, that to which I shall afterwards allude was principally done under the Drainage Act, from a grant, obtained in 1847, of £11,300, £10,400 of which has now been expended. About 1000 acres of land have been furrow-drained, and 230 acres of very stubborn waste land have been trenched, for this sum; and the extent of drains, in round numbers, stands thus—Main-pipe drains, 8772 yards; furrow-pipe drains, 213,271 yards; main-eyed stone drains, 38,907 yards; furrow-wedge stone drains, 129,627 yards; furrow metal-stone drains, 193,763 yards —equal to 332 miles, 20 yards. The estates comprehend variety of soils; and, for the sake of distinction, I shall divide the lands on which the draining has been done into three divisions.

No. I. Good deep brown loam, on a subsoil of rich yellow clay, intermixed with large whin or heathen boulder-stones, usually found at from 3 to 4 feet below the surface. The declivity for draining is good, and the land is not so much wetted by bottom springs as by an oozing out of water from the strata and slopes of the higher grounds.

No. II. Light sharp black soil, on a granite or gravelly subsoil, and parts poor gravelly clay *on pan*. Good declivity, and the large stones far more numerous, and about the same distance below the surface as in No. I. Cause of wetness nearly similar to No. I.

No. III. Blue spouty clay, and pieces of moss and boggy land, on a subsoil of blue spouty sandy clay and gravel, mixed with boulders, lying principally near the surface. Little declivity, and the wetness mostly occasioned by bottom springs, impregnated with iron.

The works commenced under my inspection in November 1847; and, to give a better idea of the construction of the drains, I shall here insert an abridged copy of the general specifications under which they were all done.

General Specifications for Draining.

The lines of drains to be marked off by the inspector, cut straight forward, and cleared of all stones, roots, and other substances; the bottoms to be made on inclined planes, to allow the water to flow freely, which will be strictly adhered to, notwithstanding undulations of the surface; and the slopes of the sides to be regular and straight, and the bottoms properly cleaned before filling.

Main stone-drains.—These are to be cut first, and remain open till the furrow-drains are finished, and must be 3 inches in the case of pipes, and 6 inches in the case of stones, deeper than the furrow-drains, at the point of junction. If not otherwise specified, they are to be 20 inches wide in bottom, and 3½ feet deep, and stone eyes built therein, 7 inches wide by 9 inches high, of good solid dyke-work; the side-walls to be 6 inches thick, covered with well-squared flat stones, with a hold of the side-walls of at least 3 inches on each side; said covers to be firmly packed at the ends with small stones, and a layer of broken 2½-inch metal neatly levelled over the whole. In building eyes, a plank, 1 inch narrower than the breadth of the conduit, to be drawn along the bottom of the drain, in order to give the builder a firm footing, and serve as a gauge for the building of the eye. Before the covers are put on, the bottom to be neatly cleaned by a hand-drawn hoe as the workman proceeds. Three feet next the mouth of the drain to be built of stone and lime, and causewayed, and an iron grating to be built in to the mouth of the drain at the back of the first cover, which must be a large heavy stone.

Furrow metal stone-drains.—When not otherwise specified, to be 4 inches wide in bottom, and 3 feet deep, filled with 2½-inch metal to the depth of 9 inches, properly harped, and put in by troughs. The metal to be broken in bins, and filled in to the drains in dry weather only.

Wedge stone-drains to be 10 inches wide in bottom, and 3 feet

deep, to be set with stones of nearly equal size, wedge-shaped, in three rows along the bottom of the drain, the tapering ends lowermost, and proper interstices for the water left between each row; the stones not to exceed 9 inches deep, and to be properly packed and levelled on the top, and covered with metal; the whole not to be above 12 inches deep.

Main and furrow pipe drains to be 9 inches wide in bottom, and 3, 3½, or 4 feet deep, scooped out to the exact size of the pipes, and the pipes laid solid and close end to end, and fixed by collars at the joinings, if the employer chooses. A yard of stone and lime to be built in the mouth of the main drain, same as stone leader.

Filling drains.—All drains to be inspected before stones or pipes are put in, and the stones or pipes to be also inspected before the mould is returned. In cutting the furrow-drains, they must be kept quite parallel to each other, the soil and subsoil all thrown to one side, and the stones to the other side. The operation of cutting to be carried on from the lower to the higher ground, and the filling from the higher to the lower ground. Where the bottom is soft and swampy, the bottoms of main and furrow drains to be causewayed with stones 6 inches deep, or laid with wood, at the employer's option. The pipes to be fixed at the joinings with good clay or collars, and the stones closely covered with good clay or turf, after which, 9 inches deep of the best subsoil is to be levelled into the drain, and firmly beaten down by a wooden mallet. The whole of the soil and subsoil to be put into the pipe-drains; and in the case of stone-drains, the remainder, after the drains have been properly filled, to be spread over the adjoining grounds equally, as a top-dressing. All furrow-drains to be filled as soon after being cut as possible, and no main drains to be covered in until the joinings therewith are completed.

The works were all done by estimate per 100 yards lineal measure; and the following Tables will give the particulars.

[TABLES

TABLES SHOWING PARTICULARS OF DRAINING AT DIFFERENT DEPTHS AND DISTANCES ON SOILS No. I., II., AND III.

SOIL No. I.

No.		Particulars of Main Drains.						Particulars of Furrow-Drains.							Total Cost of Different Divisions of the Work.				
		Depth of drains.	Drains per acre.	Cost of cutting and filling.	Cost of cutting & filling	3-inch pipes.	Cost of 3-inch pipes.	Depth of drains.	Distance of drns. apart.	Drains per acre.	Cost of cutting and filling.	Cost of cutting and filling.	1½-inch pipes.	Cost of 1½-inch pipes.	Cartage of pipes.	Cartage of stones.	Cost of pipes.	Cost of cutting and filling.	Cost of draining.
		Feet.	Yds.	Per 100 yds	Per acre.	Per acre.	Per acre.	Feet.	Feet	Yds	Per 100 yds	Per acre.	Per acre.	Per acre.	Per acre.	Per acre.	Per acre.	Per acre.	Per acre.
				£ s. d.	s. d.		s. d.				£ s. d.	£ s. d.		£ s. d.	s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1.	Pipe Drains,	3½	32	0 18 0	5 9	96	3 2	3	21	661	0 11 9	3 17 8	1983	1 15 8	19 6	—	1 18 10	4 3 5	7 1 9
		3½	32	1 0 0	6 5	96	3 2	3½	27	507	0 16 10	4 5 4	1521	1 7 4½	15 6	—	1 10 6½	4 11 9	6 17 9½
		4	32	1 0 0	6 5	96	3 2	4	33	408	1 0 0	4 1 7	1224	1 2 4	12 6	—	1 5 6	4 8 0	6 6 0
2.	Wedge Stone Drains,	3½	32	2 1 9	13 4	—	—	3	21	661	0 16 9	5 10 8½	—	—	—	1 13 0	—	6 4 0½	7 17 0½
		3½	32	2 1 9	13 4	—	—	3	24	573	0 16 9	4 15 11½	—	—	—	1 8 9	—	5 9 3½	6 18 0½
		3½	32	2 1 9	13 4	—	—	3	27	507	0 16 9	4 4 11	—	—	—	1 5 4	—	4 18 3	6 3 7
3.	Metal Stone Drains,	3½	32	2 1 9	13 4	—	—	3	21	661	1 2 0	7 5 5	—	—	—	1 13 0	—	7 18 9	9 11 9
		3½	32	2 1 9	13 4	—	—	3	24	573	1 2 0	6 6 1	—	—	—	1 8 9	—	6 19 5	8 8 2

[Continued.

TABLES SHOWING PARTICULARS OF DRAINING.—(*Continued.*)

SOIL No. II.

No.		Particulars of Main Drains.						Particulars of Furrow-Drains.							Total cost of Different Divisions of the Work.				
		Depth of drains.	Drains per acre.	Cost of cutting and filling.	Cost of cutting & filling	3-inch pipes.	Cost of 3-inch pipes.	Depth of drains.	Distance of drns. apart.	Drains per acre.	Cost of cutting and filling.	Cost of cutting and filling.	1½-inch pipes	Cost of 1½-inch pipes.	Cartage of pipes.	Cartage of stones.	Cost of pipes.	Cost of cutting and filling.	Cost of draining.
		Feet	Yds.	Per 100 yds	Per acre.	Per acre.	Per acre.	Feet.	Feet.	Yds.	Per 100 yds	Per acre.	Per acre.	Per acre.	Per acre.	Per acre.	Per acre.	Per acre.	Per acre.
				£ s. d.	s. d.		s. d.				£ s. d.	£ s. d.		£ s. d.	s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1.	Pipe Drains,	3½	32	0 16 7	5 3½	96	3 2	3	21	661	0 14 1	4 13 1	1983	1 15 8	19 6	—	1 18 10	4 18 4½	7 16 8½
		4	32	1 0 0	6 5	96	3 2	3½	27	507	0 16 6	4 3 8	1521	1 7 4½	15 6	—	1 10 6½	4 10 1	6 16 1½
		4	32	1 0 0	6 5	96	3 2	4	33	408	0 19 0	3 17 6	1224	1 2 0	12 6	—	1 5 6	4 3 11	6 1 11
		4	32	1 0 0	6 5	96	3 2	4	36	371	0 19 0	3 10 5½	1113	1 0 0	11 8	—	1 3 2	3 16 10½	5 11 8½
2.	Wedge Stone Drains,	3½	32	2 10 0	16 0	—	—	3	21	661	1 0 0	6 12 2	—	—	—	1 13 0	—	7 8 2	9 1 2
		3½	32	2 10 0	16 0	—	—	3	24	573	1 0 0	5 14 7	—	—	—	1 8 9	—	6 10 7	7 19 4
		3½	32	2 10 0	16 0	—	—	3	27	507	1 0 0	5 1 4½	—	—	—	1 5 4	—	5 17 4½	7 2 8½
3.	Metal Stone Drains,	3½	32	2 10 0	16 0	—	—	3	27	507	1 6 0	6 11 10	—	—	—	1 5 4	—	7 7 10	8 13 2
		3½	32	2 10 0	16 0	—	—	3½	33	408	1 12 0	6 10 7	—	—	—	1 0 5	—	7 6 7	8 17 0
		3½	32	2 10 0	16 0	—	—	4	39	340	2 0 0	6 16 0	—	—	—	0 17 0	—	7 12 0	8 9 0

[*Continued.*

TABLES SHOWING PARTICULARS OF DRAINING.—(*Concluded.*)

SOIL No. III.—(Spouty Clay.)

No.		Particulars of Main Drains.						Particulars of Furrow-Drains.							Total Cost of Different Divisions of the Work.				
		Depth of drains.	Drains per acre.	Cost of cutting and filling.	Cost of cutting & filling	3-inch pipes.	Cost of 3-inch pipes.	Depth of drains	Distance of drns. apart.	Drains per acre.	Cost of cutting and filling.	Cost of cutting and filling.	1½-inch pipes.	Cost of 1½-inch pipes.	Cartage of pipes.	Cartage of stones.	Cost of pipes.	Cost of cutting and filling.	Cost of draining.
		Feet.	Yds.	Per 100 yds	Per acre.	Per acre.	Per acre.	Feet.	Feet.	Yds.	Per 100 yds	Per acre.	Per acre.	Per acre.	Per acre.	Per acre.	Per acre.	Per acre.	Per acre.
				£ s. d.	s. d.		s. d.				£ s. d.	£ s. d.		£ s. d.	£ s. d	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1.	Pipe Drains,	3½	32	1 10 0	9 7	96	3 2	3	15	936	0 15 6	7 5 7	2808	2 10 6½	1 6 8	—	2 13 8½	7 15 2	11 15 6½
		3½	32	1 10 0	9 7	96	3 2	3	18	776	0 15 6	6 0 3	2328	2 1 11	1 2 8	—	2 5 1	6 9 10	9 17 7
		3½	32	1 10 0	9 7	96	3 2	3	21	661	0 15 6	5 2 5½	1983	1 15 8	0 19 6	—	1 18 10	5 12 0½	8 10 4½
2.	Wedge Stone Drains,	3½	32	2 5 0	14 5	—	—	3	18	776	0 18 6	7 3 6½	—	—	—	1 18 9	—	7 17 11½	9 16 8½
		3½	32	2 5 0	14 5	—	—	3	21	661	0 18 6	6 2 3½	—	—	—	1 13 0	—	6 16 8½	8 9 8½

SOIL No. III.—(Moss and Boggy Land.)

No.		Depth of drains.	Drains per acre.	Cost of cutting and filling.	Cost of cutting & filling	3-inch pipes.	Cost of 3-inch pipes.	Depth of drains	Distance of drns. apart.	Drains per acre.	Cost of cutting and filling.	Cost of cutting and filling.	1½-inch pipes.	Cost of 1½-inch pipes.	Cartage of pipes.	Cartage of stones.	Cost of pipes.	Cost of cutting and filling.	Cost of draining.
1.	Pipe Drains,	3½	32	0 17 3	5 6	96	3 2	3½	18	776	0 17 3	6 13 10	2328	2 1 11	1 2 8	—	2 5 1	6 19 4	10 7 1
		3½	32	0 17 3	5 6	96	3 2	3½	21	661	0 17 3	5 14 0	1983	1 15 8	0 19 6	—	1 18 10	5 19 6	8 17 10
		3½	32	0 17 3	5 6	96	3 2	3½	24	573	0 17 3	4 18 10	1719	1 10 11	0 17 3	—	1 14 1	5 4 4	7 15 8
2.	Wedge Stone Drains,	3½	32	2 0 0	12 9½	96	—	3	21	661	0 15 0	4 19 2	—	—	—	1 13 0	—	5 11 11½	7 4 11½
3.	Metal Stone Drains,	3½	32	2 3 0	13 9	—	—	3	21	661	1 0 0	6 12 2	—	—	—	1 13 0	—	7 5 11	8 18 11
		3½	32	2 6 0	14 8½	—	—	3½	24	573	1 4 6	7 0 4½	—	—	—	1 8 9	—	7 15 1	9 3 10

Note.—The works were chiefly done in 1848 and 1849, when wages were very high.

In the foregoing Tables it will be observed that, in some cases, the main and furrow drains are of the same depth: this deviation from the ordinary rule was occasioned by a quick falling of the ground, which rendered deeper main-drains unnecessary.

Remarks on Table, Soil No. I.

1. *Pipe-drains.*—At 3 feet deep and 21 feet apart, a uniform dryness has been the result. At 3 feet deep and ·27 feet apart, the land has been tolerably dried, but not quite so effectually as in the last case. At 4 feet deep and 33 feet apart, the land is but very imperfectly dried, particularly in the centre between the drains, where it still retains a damp bleak appearance after heavy rains, and that to a late period in spring.

2. *Wedge stone-drains.*—At 3 feet deep and 21 feet apart, the land is perfectly dried; it is equally so at 24 feet apart, and the same depth; but at 3 feet deep and 27 feet apart, the land is not thoroughly dried, and the drains appear to lose their proper effect after 24 feet.

3. *Metal stone-drains.*—At 3 feet deep and 21 feet apart, a perfect dryness has been obtained. At 3 feet deep and 24 feet apart, I think they have scarcely produced the same effect.

I consider this soil best suited for pipes; they have dried the land generally as well as stones, and considerably cheaper, and appear to answer best at 3 feet deep and 21 feet apart. The pipes can also be more firmly and safer laid than in hard stony land; I am, therefore, inclined to give the preference to this plan, unless an open porous bottom could be reached at 4 feet, and, in that case, 4-feet-deep drains, at 33 feet apart, might be equally effective, and also less expensive. I am aware that a certain deepness is imperative for the permanent safety of the pipes; but as soils of this sort will not subside much for a long time, I presume that pipes laid at a depth of 3 feet will be perfectly safe from all external injuries for a long series of years. On this description of soil the drainage has produced a very marked and beneficial effect, particularly on grain crops, turnips, and grass, the turnips yielding 25 tons an acre where 10 tons did not grow before. Grain crops have been also much increased—oats on an average of fully 2 quarters an acre.

Remarks on Table, Soil No. II.

1. *Pipe-drains.*—At 3 feet deep and 21 feet apart, the result has been perfect drainage; and at 3½ feet deep and 27 feet apart, it has been equally satisfactory. At 4 feet deep and 33 feet apart, the effect is very fair, although not quite so marked as the others; and at 4 feet deep and 36 feet apart, the drainage is by no means bad.

2. *Wedge stone-drains.*—In this case, we have only 3-feet-deep drains, at 21, 24, and 27 feet apart. In the two former cases a

thorough dryness has been produced; but in the latter, 27 feet apart, it is not exactly what could be wished, and the drains seem to be losing their proper effect at that distance.

3. *Metal stone-drains.*—At 3 feet deep and 27 feet apart, the result is similar to wedge-drains at the same depth and distance. At $3\frac{1}{2}$ feet deep and 33 feet apart, the effect produced is quite satisfactory; and at 4 feet deep and 39 feet apart, it is far from bad draining.

This soil I consider well adapted for deep draining, seeing that, as the depth increases and the distances apart, the effects are good, and the expense considerably lessened. It may be done either with pipes or stones; but, from the difficulty of getting pipes to lie firm in a rough stony bottom, I should prefer stones where they can be had conveniently and suitable, even at a little more expense. If good stones can be got, I consider the wedge-drain best: it is not so liable to injury from small obstructions as metal or pipes, and will, no doubt, prove lasting in firm-bottomed ground, and can be constructed at less expense than the metal drain.

On this description of soil draining has, no doubt, its advantages; but it will not repay the outlay above one-half of the ratio in soil No. I.—the expense of workmanship being invariably higher, and the extra increase of crops fully a half less than No. I. On the poorer sorts of this kind of land, I am very sceptical whether the extra produce obtained by draining will repay the interest of the outlay to the extent of $6\frac{1}{2}$ per cent. per annum.

Remarks on Table, Soil No. III.

(Spouty, or Boiling Clay.)

1. *Pipe-drains.*—At 3 feet deep and 15 feet apart, the land has been rendered tolerably dry. At 3 feet deep and 18 feet apart, the effect has been but very indifferent; and at 3 feet deep and 21 feet apart, the land was not nearly dry, and in some parts must be drained a second time.

2. *Wedge stone-drains.*—At 3 feet deep and 18 feet apart, the drainage was pretty effectual; but at 3 feet deep and 21 feet apart, it was not perfectly dry, although better than the pipe-draining.

Of all soils on which draining has been attempted, this is doubtless the most difficult to dry; it retains water like a sponge, and when exposed to the air, soon becomes a thin pulpy substance, nearly as adhesive as glue. I am of opinion that the drains should not be more than 3 feet deep, and pretty close together, as in many places an open bottom could not be obtained at 8 or 10 feet deep. I find wedge stone-drains preferable to pipes, in as far as they give more space, and are not so liable to be silted up. In the softest parts, I have always set the stones on wooden soles, 8 inches broad, and half an inch thick, and found it to answer well: it will no doubt prove lasting, either in clayey or mossy damp land.

The wood costs, at the saw-mills here, about eight shillings per 100 lineal yards of drain. The drains should be cut in short lengths, say about 80 or 100 yards; and when the land is flat, the run may be increased by making the drains deepest at the junction with the main drain—say 3½ feet deep there, 3 feet deep in the middle, and 3 or 2½ feet at the top, as may be required. When pipes must be used, they should never be less than 2 inches diameter, laid on soles of wood, and fixed by collars. The drainage of such land should always be performed in summer, and I find it best to have the filling in close up after the drainers. In fact, any other system is almost impracticable, hazardous for the safety of the work, and also increases the workmanship; for, whenever the soil is exposed to the air, it will boil up in the bottom, and tumble in on the sides. Well-heads or quagmires are generally to be found in this sort of land, which I have frequently dried by sinking pits in them to the depth of 5, 6, or 7 feet, or till something like a firm bottom was obtained, and filling them with stones as high as the adjoining drains, and carrying off the water by a branch stone-drain to the leader. This kind of land, when effectually dried and liberally manured, has always produced superior crops; but, as the expense of draining must necessarily be extravagantly high, it is only in some favoured localities, either for improving the climate or beautifying the place, that it is advisable to undertake such improvements.

Remarks on Table, Soil No. III.

(Moss and Boggy Land.)

1. *Pipe-drains.*—In this case, they are all 3½ feet deep, 18, 21, and 24 feet apart, and in every case the land has been thoroughly dried. At 18 feet apart, the moss was in some places very deep, so that the drains could not be cut through it for want of run; they were therefore cut 3½ feet, and the pipes laid on soles of wood at 21 and 24 feet apart. The drains, in most cases, went fully through the moss, and, the bottom being firm sandy clay, they required no soles.

2. *Wedge stone-drains.*—These were 3 feet deep and 21 feet apart; and the moss being shallow, they went about 18 inches into the subsoil, and have most effectually dried the land.

3. *Metal stone-drains.*—These were 3 and 3½ feet deep, at 21 and 24 feet apart, mostly through the moss. They have to a certain extent failed in producing dryness, and being subject to collect sediment and iron ore, and are also high-priced, I therefore consider them unsuitable for draining such land.

For mossy land, I am of opinion that the above-mentioned depths should be increased: the moss subsides much after being dried, and the drains will, in course of time, be too near the surface. In such land, they should always be a foot or two into

the subsoil, if possible. At all events, they should never be less than 4 or 5 feet deep, and bottomed with wood, where the subsoil cannot be reached. Two feet deep of clayey subsoil from the bottom of the drains would amply pay the cost of extra cutting, in the shape of manure to the adjoining surface of the mossy ground. I consider wedge stone-drains best for this land; but, if pipes must be used, they should be of 2-inch bore, and the joinings fixed by collars, which cost about three shillings per 100 lineal yards of drain at the pipe-work. The length of lines should in no case be above 80 or 100 yards. The cost by the acre is increased in consequence of the materials requiring to be carried or wheeled along the drain by men. The return of crops has been excellent—certain to repay the outlay.

Concluding Remarks.

I need scarcely add, that the lines of drains were always laid on the best declivity, running right to the hill, or higher grounds, and the depths and distances regulated according to the nature of the subsoil. On steep land, subject to be wetted from the higher grounds, a drain has been put in across the top of the field, and the parallel drains connected with it, which I have found very useful for cutting off the water from the undrained land. In such cases this should never be omitted. The extreme length of stone-drains has been seldom over 200 yards, and that of pipes, as far as practicable, confined to 150 yards; but when necessity required these to be more, and where the discharge of water was expected to be great, from very wet land, or deep drains, at a greater distance apart, the precaution was taken of laying about 50 yards of the lower end with pipes of 2-inch bore. In the commencement of the works, some pipe-drains were inadvertently laid, in very wet land, with 1½-inch pipes, at lengths of 220 yards, and the first flood completely overcharged them; so that main drains had to be cut across the middle of the fields, to prevent the total destruction of the drainage. The outfall is the primary part of all good drainage; and to secure a good one, and keep it clean, are objects of the last importance, and ought to be well attended to, otherwise the main drain soon gets silted up, especially in flat lands, and must ultimately destroy the whole drainage therewith connected. It is, however, difficult to get this properly attended to over a large estate; but, as a substitute, the outfalls of this drainage have chiefly been constructed so as to give a drop or fall of 9 or 12 inches from the mouth of the main drain. With the exception of some small failures, the drainage, upon the whole, has proved effectual. These failures have been chiefly in pipe-drains; and, on examination, are found to be caused either by broken pipes, or pipes silted up by a soft sandy sediment resembling plaster-lime, which has run hard in the pipes—the result of laying them improperly, without soles or collars, through soft, swampy, clayey spots of land,

and sometimes in consequence of old drains or springs throwing in more water than the pipes could discharge. The pipes of themselves were quite fresh—no sign of going to decay, as some parties averse to pipe-draining affirm. I have little doubt of their durability, if *well burned* and properly laid in drains and soils suitable for them. About a quarter of a million of pipes has been laid here with collars, which I consider an excellent safeguard for them.

In summing up the foregoing results, it may be inferred that every description of drains has produced its results to a certain extent, according to the nature of the soil to which it was applied. Pipe-drains I have no objection to; but more care is required in laying them, and they are more easily obstructed. Wedge stone-drains I consider to be very excellent; and in this country, where stones are plentiful, should not be lost sight of. Metal stone-drains answer well in firm land; but, from the expense of construction, are likely to fall into disuse. At present, the deep-draining mania prevails, and its advocates tell us that 4 feet deep should be the lowest standard under all circumstances, and on every description of land. This is nearly tantamount to the quack pills curing all diseases to which the human body is subject. My firm opinion is, that the depth, distance apart, and description of drains, should in all cases be regulated according to the nature of the soil and subsoil to which they are to be applied.

I have now endeavoured to give the subject a candid and *impartial exposition*, as far as my experience and observation enable me to do; and should it be found to afford useful information on draining, or tend to remove doubts which have hitherto existed, my object in preparing this report will be fully realised.

TABLE showing the WEIGHTS of TURNIPS on VARIOUS FARMS in the MIDDLE and UPPER DISTRICTS of ANNANDALE.

Inspected between 1st and 23d November, 1852.*

Names of Farms, Parishes, and Kinds of Turnips.	Width of Drill in Inches.	No. of Turnips on 10 lineal Yards.	Weight. Per Scotch Acre.	Weight. Per Imp. Acre.	Manure per Scotch Acre. Farmyard Dung	Peruvian Guano.	Agamos Guano.	Sal. Bay Guano.	Ground Bones.	Dissolved Bones.	Bone Dust.	Native Guano.	Date of Sowing.
			tons cwt	tons cwt	cubic yards	lb	cwt	cwt	bus	lb	cwt	cwt	
HARDGRAVE, *Dalton*,													
Yellow Bullock, . .	26	28	26 8	20 18	8	180			8	67			31 May and 1 June
Hardy Green, . . .	26	28	33 19	26 18	8	180			8	67			3d to 7th June
Skirving's Swede, . .	26	26	30 18	24 10	9¾	224			9	90			22d May
Hardy Green, . . .	27	24	35 4	27 18	8	180			8	67			25th May
Purple Top Yellow .	27	27	22 10	17 17	8	180			8	67			26 to 28 May
DORMONT, *Dalton*,						cwt.							
White Globe, . . .	26	32	25 13	20 6		1			16		1½		15th June
Skirving's Swedes, .	26	35	20 7	16 3	10	1			8		½		25 to 26 May
Hardy Green, . . .	26	40	17 7	13 15	10	1			8		½		11 to 15th June
White Globe, . . .	26	36	13 11	10 15	10	1			8		½		Do. do.

* Though this Report has already appeared in an agricultural newspaper, it is published by the Society in connection with the Reports on the same subject of 1849, 1850, and 1851, and for the purpose of permanently recording the results of experiments so important as those detailed.

[*Table continued.*

Names of Farms, Parishes, and Kinds of Turnips.	Width of Drill in Inches.	No. of Turnips on 10 lineal yards.	Weight. Per Scotch Acre.	Weight. Per Imp Acre.	Manure per Scotch Acre. Farmyard Dung	Peruvian Guano.	Agamos Guano.	Sal Bay Guano.	Ground Bones	Dissolved Bones.	Bone Dust	Native Guano.	Date of Sowing.
			tons cwt	tons cwt	cubic yards	cwt	cwt	cwt	bus	cwt	cwt	cwt	
HALLEATHS, *Lochmaben,*													
Skirving's Imperial Swede, ...	27	37	34 3	27 1	18			1½		1½			24 to 26th May
Do. do.	26	38	36 11	29 0	18			1½		1½			29 and 31 May
Laing's do.	26½	38	36 5	28 15	18			1½		1½			31st May
GREENHILLHEAD, *Lochmaben,*													
Curwen's Swede, . .	26	37	31 10	24 19	20	3							23d May
Skirving's Do.	26	34	39 4	31 2	20	3							23d May
Do. Scotch Grown,	24	38	32 6	25 12	20	3							24th May
Purple Top Yellow, .	25	37	19 11	15 10	20	3							Do.
SMALLHOLM, *Lochmaben,*													
Swedes, ...	27½	32	25 10	20 4		2			12				1st June
Green Top Swedes, .	27½	31	22 2	17 10		2			12				3d June
Do. do. . .	27½	32	26 0	20 13		2				4			4th June
BROADCHAPEL, *Lochmaben,*													
Swedes, ...	27	32	28 6	22 9		2		1		2			29th May
Pomeranian White, .	27	40	25 8	20 3		2		1		2			27th June
DALFIBBLE, *Kirkmichael,*													
Swedes, ...	27	32	35 12	28 4	17	2½			12				8th May
White Globe, . . .	27	40	39 12	31 3	17	1¼		1¼	10				1st June
Yellow Bullock, . .	27	38	23 13	18 14	17	1¼		1¼	10				3d June
GEMRIGG, *Kirkmichael,*													
Swedes, ...	28	28	26 17	21 7	15	2½			12				28th May
White Globe, . . .	26	28	30 3	23 18	15	2½							29th May
HILLSIDE, *Dryfesdale,*													
Skirving's Purple Top Swede, ...	28	28	36 1	28 12	27		2			3⅜			22 to 26th May
Laing's Swede, . . .	28	28	29 1	23 1	25	2				3⅜			26 and 27 May
Pomeranian White, .	28	30	38 10	30 11	25	2				3⅜			27th May
Hardy Green, . . .	28	34	28 0	22 4	30	2							10th June
Yellow Bullock, . .	28	31	20 6	16 2	30	2							10th June
Hill Field do. . . .	27	31	19 12	15 11	22		2						28th May
Do. do. . . .	27	33	20 6	16 2		2							28th May
KIRKBURN, *Dryfesdale,*													
Green Top, ...	28	31	25 18	20 11	15	2			10				10th June
Pusey's Red Top, . .	28	33	33 12	26 13	15	2			10				7th June
Yellow Bullock, . .	28	31	23 2	18 6	15	2			10				19th June
Laing's Swedes, . . .	28½	30	27 4	21 11	25	2			15				20th May
Skirving's do., . . .	28½	30	33 7	26 9	25	2			15				22d May
Yellow Bullock, . .	28	29	24 17	19 14	15	2			10				5th June
BROOMHOUSES, *Dryfesdale,*													
White Globe, . . .	28	32	32 18	26 2		2			14				15th May
Yellow Bullock, . .	28	41	21 14	17 4	28	2							9th June
Swedes, ...	27	36	25 1	19 17	28	2							25 and 26 May
Purple Top Yellow, .	29½	43	19 19	15 16	28	2							4th June
KING'S ARMS, *Dryfesdale,*													
Swedes, ...	30	32	25 3	19 19	25	3							22d May
Yellow Bullock, . .	30	36	19 12	15 11	25	3							Do.
BLACKFORD, *Dryfesdale,*													
Mixed Swedes, . . .	29	38	28 1	22 5	14	2			12				15 and 16 May
BECKTON, *Dryfesdale,*													
Swedes, ...	27½	30	32 2	25 9	25	2							29th May
Yellow Bullock, . .	27½	36	21 8	16 19	22	2							22d May
White Globe, . . .	27½	36	29 0	22 18		2			20				25 and 27 May
Hardy Green, . . .	27½	33	33 10	26 11		2			20				28th May
Yellow Bullock, . .	27½	41	21 15	17 5		2			20				29th May
HIGHLAW, *St Mungo,*													
Yellow Bullock, . .	26	40	8 13	6 16	12	2							24 and 26 June
White Globe, . . .	26	34	18 2	14 6	12	2							Do. do.
Mixed Swedes, . . .	26	35	24 2	19 2	12	2							4th to 7th June
Yellow Bullock, . .	26	36	18 2	14 6		3							Do. do.
LAMMONBIE, *Applegarth,*													
Yellow Bullock, . .	29½	46	20 5	16 1	15			–	10				5 to 12 June
Purple Top Swedes, .	29½	37	27 12	21 17	20	2							22 to 27 May
Green Top do., . . .	29	45	26 14	21 3	20	2							Do. do.
Yellow Bullock, . .	29	40	13 17	10 19	15								12th June

[*Table continued.*

Names of Farms, Parishes, and Kinds of Turnips.	Width of Drill in Inches.	No. of Turnips on 10 lineal Yards.	Weight. Per Scotch Acre.	Weight. Per Imp. Acre.	Manure per Scotch Acre. Farmyard Dung.	Peruvian Guano.	Agamos Guano.	Sal. Bay Guano.	Ground Bones.	Dissolved Bones.	Bone Dust.	Native Guano.	Date of Sowing.
			tons cwt	tons cwt	cubic yards	cwt	cwt	cwt	bus	bus	cwt	cwt	
Dinwoodie Mains, *Applegarth*,													
Swedes, ...	28	33	31 3	24 14	18	4							20th May
Do., ...	29	37	30 8	24 2	18	4							25 and 27 May
Purple Top Yellow, .	28	37	25 11	20 5	15	2							16 and 17 June
Hardy Green, . . .	28	44	31 3	24 14	15	2							Do. do.
White Globe, . . .	28	37	34 13	27 10		3							28th June.
Kirkcroft, *Applegarth*,													
Swedes, ...	29	39	32 9	25 14	20	3½							18th May
Yellow Bullock, . .	29	44	22 6	17 14	15	2							Do.
Do. do., . . .	29	43	19 19	15 16		3½							Do.
Purple Top Yellow, .	29	39	21 12	17 3		3½							26th May
Hardy Green, . . .	29	33	26 7	20 18	20								Do.
Shaw, *Hutton*,													
Yellow Bullock, . . .	28	25	17 10	13 17	15	2½							10th June
Pomeranian White, .	28	33	28 7	22 10	18	2½							6th June
Hardy Green, . . .	28	35	36 1	28 12	18	2½							5th June
Green Top Swede, . .	28	35	30 2	23 17	25	2½							24th May
Purple Top Swede, .	28	29	35 7	28 1	25	2½				1½			22 and 23 May
Annanbank, *Johnston*,													
Swedes, ...	28	29	28 13	22 15	24	2							20 to 26 May
H. Green and Yellow,	27	34	21 8	16 19	24	2							Do. do.
Yellow Bullock, . . .	27½	32	19 12	15 11	24	2							Do. do.
White Globe, . . .	27½	30	36 11	29 0	16	1½							1 to 12 June
Purple Top Yellow, .	27½	32	21 1	16 12	16	1½							Do. do.
Hardy Green, . . .	27½	32	32 2	25 9	16	1½							Do. do.
Swedes, ...	28½	31	21 0	16 13	18							2	27th May
Johnstone-cleugh, *Johnston*,													
Hardy Green, . . .	27	37	30 3	23 18	18	2							23d May
Swedes, ...	27	48	20 6	16 2	18	2							23d May
Purple Top Yellow, .	27	41	22 17	18 3	18	2							24th May
Gregsland, *Johnston*, .													
Purple Top Yellow, .	27	52	21 16	17 5	15	2							1 to 12th June
Yellow Bullock, . .	27	48	20 14	16 8	15	2							Do. do.
Swedes, ...	27	51	29 8	23 6	15	3				cwt			20 and 29 May
Purple Top Yellow, .	27	59	19 19	15 16		2				5			26th June
White Globe, . . .	27	53	33 8	26 10		2				5			Do.
Hardy Green, . . .	27	48	26 17	21 6		2				5			Do.
Kirkbank, *Johnston*,													
Yellow Bullock, . .	27½	36	17 2	13 11	18	2							2d June
Swedes, ...	28	36	28 7	22 10	26	2							14 and 15 May
Hardy Green, . .	28	33	33 5	26 7	18	2							21st May
Woodend, *Johnston*,										bush			
Yellow Bullock, . .	27½	45	25 13	20 1		3				6			1st and 2d June
White Globe, . . .	28	46	40 12	32 3		3				6			Do. do.
Purple Top Yellow, .	27	50	20 13	16 2	15	2						1	25 and 27 May
Yellow Bullock, . .	27	47	19 12	16 11	15	2						1	Do. do.
Saughtrees, *Wamphray*,													
Swedes, ...	27½	40	19 5	15 5	20	1		1					8th June
White Globe, . . .	27½	42	36 15	29 2	20	1		1					9th June
Swedes, ...	27½	38	29 12	23 9	20	1		1					24th May
Yellow Bullock, . .	27	44	18 17	14 19	20	1		1					25 to 29th May
Broomhills, *Wamphray*,													
Swedes, ...	29	40	31 1	24 18	20	3							21st May
Hardy Green, . . .	27	42	25 1	19 16		4							12th June
Yellow Bullock, . .	27	44	22 3	17 11	16	3							1st and 2d June
Pumplaburn, *Wamphray*,													
Yellow Bullock, . .	26½	41	25 3	19 19	18	2		2					18th May
Swedes, ...	27	35	33 1	26 4	18	2		2					19th May
Yellow Bullock, . .	27½	37	29 5	23 4	18	2		2					22d May
Wamparaygate, *Wamphray*,													
White Globe, . . .	27	42	34 3	27 1	20	2							5th June
Yellow Bullock, . .	27	38	26 10	20 1	18	2½							15th June
Purple Top Yellow, .	27	36	21 1	16 14	20	2							5th June
Skirving's Swede, . .	28	37	32 18	26 1	30	3							26th May
Ashcroft's do., . .	28	35	30 2	23 17	30	3							Do.
Yellow Bullock, . .	27	32	25 8	20 3	20	2							31st May

[*Table continued.*

Names of Farms, Parishes, and Kinds of Turnips.	Width of Drill in Inches.	No. of Turnips on 10 lineal yards.	Weight. Per Scotch Acre.	Weight. Per Imp. Acre.	Manure per Scotch Acre. Farmyard Dung	Peruvian Guano.	Agamos Guano.	Sal. Bay Guano.	Ground Bones.	Dissolved Bones.	Bone Dust.	Native Guano.	Date of Sowing.
			tons cwt	tons cwt	cubic yards	cwt	cwt	cwt	bus	bus	cwt	cwt	
KIRKHILL, *Wamphray*,													
White Globe, . . .	27½	35	24 12	19 10	18	2				4			18th June
Hardy Green, . . .	26½	36	24 16	19 13	18	2				4			24th June
Purple Top Yellow, .	27	38	20 14	16 8	18	2							18th June
Yellow Bullock, . .	27	36	29 15	23 12	28	2½							11th June
Do. do., . . .	27	36	21 1	16 14	20	2							12th June
Do. Laurie's, . . .	27	39	31 12	25 1	25	2							14th June
White Globe, . . .	28	32	37 2	29 8	18	2							26th May
Swedes, ...	27½	37	34 5	27 3	27	2							25th May
PALACEKNOWE, *Kirkpatrick-Juxta*,										cwt			
River's Swede, . . .	29½	24	28 0	22 4	20		4			4			6th May
Laing's do., ...	29½	27	27 18	22 3	20		4			4			Do.
Skirving's do., . . .	29½	29	27 5	21 12	20		4			4			Do.
Hardy Green, . . .	29	23	27 14	21 19	30		1			2			15th May
Aberdeen Yellow, .	29	25	21 19	17 8	30		1			2			Do.
Yellow Bullock . .	29	25	21 12	17 2	30		1			2			Do.
NEWTON, *Moffat*,													
Hardy Green, . . .	27	36	39 19	31 13	25	2							20th May
Swedes, ...	27	32	35 4	27 18	25	2							21st May
Yellow, ...	27	33	23 12	18 14	25	2							22 and 24 May
Purple Top Yellow, .	27	39	27 4	21 12	25	2							27th May
CAPELGILL, *Moffat*,													
White Globe, . . .	27	38	40 6	31 19	18	2½							22d May
Yellow, ...	27	40	25 8	20 3	18	2½							22 and 24 May
Purple Top Yellow, .	27	40	27 4	21 12	18	2½							Do. do.

AVERAGE WEIGHT.

	Scotch. tons cwt	Imperial. tons cwt
For Swedes, ...	29 10	23 7
,, Yellow, ...	22 0	17 7
,, Common, ...	30 0	23 14

AVERAGE WEIGHT OF THE FOUR LAST CROPS.

PER IMPERIAL ACRE.

	1849. tons cwt	1850. tons cwt	1851. tons cwt	1852. tons cwt
For Swedes, ...	21 16	24 9	19 16	23 7
,, Yellow, ...	20 2	19 14	17 0	17 7
,, Common, ...	22 7	25 14	21 1	23 14

These various trials of the crops referred to extend over between 600 and 700 acres, and they incline the reporter to a very confident opinion that they exhibit a correct average of the fields weighed.

25th November 1852. M. MARTIN.

LOCKERBIE, *Nov.* 25, 1852.

REPORT OF THE LOCKERBIE FARMERS' CLUB ON THE PRECEDING TABLE.

Mr Martin, appraiser and land-surveyor, Moffat, had been employed by the Club this year to make the annual inspection of the turnip crops of the district. As directed, he had inspected the fields of such of the members as he could conveniently reach, with a few neighbouring farms where the extent of turnips was considerable. He had begun his inspection on the 1st November, and, having completed it, he produced to the meeting of the Club today the preceding Table. He also gave in a Table of a great variety of different experiments, which had been made by members

and other individuals,—of which latter, three are selected from different parts of the districts, and at various elevations of 100 to 800 feet above sea-level, and are directed to be printed on a sheet separate from the General Table and Report, believing that these, as well as the General Table, will be received with interest by the farmers of the district, though in this year's publication, as they are aware, from the peculiarities of the season, the Table and experiments elicit much less than in former years, for future guidance in management and manuring.

The members present expressed their unanimous conviction that Mr Martin had executed his task with great care, selecting his averages for weighing in the different fields with much accuracy; and he stated that the extent of turnip crop, of which the Table represented the average, was from 600 to 700 acres on the farms enumerated.

Mr Martin accompanied the Table with a variety of written remarks which he had made in the course of inspection; and these being fully discussed at this meeting, the following is the substance of the opinions of the members as expressed on different points *seriatim*, following the order adopted in the reports of preceding years.

GENERAL DESCRIPTION OF THE SEASON AND EFFECT ON THE CROP.

The season, with the interruption of about a week of wet weather from the 10th to the 18th of May, had been very favourable for sowing; and the farmers of the district generally, now impressed with the advantage of early sowing, having availed themselves of it, the swedes were nearly all put in before the 26th May, the other sorts rapidly following, and the whole nearly completed by the 15th of June. The weather forward till the middle of August was most favourable for quick growth, and never at that date had they attained so large a size and maturity; but they had been too rapidly forced on, and the weather continuing unusually warm, with a deficiency of moisture, a premature check to the growth and decay of the shaw took place; and thus the bulk has been less than was anticipated, of the yellow turnip in the greatest degree, of the white varieties next, and swedes to a less degree. But the greater comparative weight of this last turnip is evidently, in some degree, owing to the increased attention and manure bestowed on it in this district. The disappointment in general bulk is greater in gravelly and much cropped soils, when contrasted with those of land on higher situations more kept in grass, even where the tillage was coarser and more imperfect.

DISEASES.

Mr Martin remarked, that on going over fields he found three distinct diseases had prevailed to some extent. Finger and Toe, which, though observable in many fields, did not materially affect

the weight, excepting in a very limited portion in the south of the district; and he could scarcely say that the weight of any field inspected was diminished by it, excepting on the farm of Hardgrave, where it prevailed to a considerable extent. A species of this disease had, however, in July, destroyed on many farms a small per-centage of plants which had totally disappeared—a rot which completely and quickly destroys the turnip at its full growth, in most fields of white and yellow perhaps 1 per cent, but in a few to the length of 5 to 10 per cent. This is larger than in former years. The black crack, with a partial disease of the bulb, is confined to swedes, and more extensive than usual, but generally from 2 to 5 per cent, though occasionally greater.

Though diseases may be said to be more apparent, and perhaps more extensive than formerly, the Club think it very possible they may proceed from the peculiarities of the season, and not from any increasing liability, in the turnip crop generally, to disease in the district.

GENERAL WEIGHT OF THE DISTRICT.

This point underwent considerable discussion. And the general opinion of the members present, when stated by an average, might be, that though the weights indicated accurately those of the farms taken, they would exceed those of the whole district by 10 per cent on the common white, 5 per cent on the yellow, and 7 per cent on the swedes.

TIME OF SOWING.

The specialities of the weather of this season did not admit of any fair inference being drawn from the Table in this respect. But, on the whole, the members were disposed to adhere to the opinion in their former report—viz: That swedes should be sown from the 10th to the 20th of May, and that later than the 25th risked the weight of the crops; that white, for consumption in September, should be sown early in May, and again partially as the last of the season; that yellow should be after swedes, and as few as possible after the 15th of June—though certain members remarked, that on free and quick soils they would prefer a portion rather later, to insure nutritious food for sheep in spring.

WIDTH OF DRILL AND HOEING.

It will be seen that the width of drill generally is from 26 to 29 inches; but the opinion of many members seemed in favour of more discrimination. On level rich land, swedes well manured might be as wide as 30 or 31 inches; while on hard gravelly soils, and on exposed and steep fields, yellow might be in some cases only 24 or 25.

As to width of hoeing, though in some instances, from the peculiarly early falling down of the leaves, narrower thinning

seemed advantageous, yet on the whole the Club adhere to their recommendation of 10 to 13 inches.

VARIETIES OF KINDS OF TURNIPS.

The yellow bullock turnip, having shown even a greater deficiency of weight than formerly, led to a discussion whether they should not be further diminished in extent, occupying, as they yet do, from a third to two-fifths of the extent of the crop. The arguments in last year's Report are referred to. It is now generally agreed that, for consumption of sheep and store cattle, up to nearly the middle of January, the common white should be relied on, as the largest bulk and best for the land. As active and early preparation of land, so as to be sown by 25th May, and a greater application of extra manures prevails, and as the cutter is more used in the spring, the swedes will encroach on the extent of yellow; though it must be admitted that, in late and cold seasons, the former are subject to more casualties. At present, however, on Hardgrave and other well-cultivated lands in the lower districts, the proportion of yellow is comparatively very small.

One member, having experience of Skirving's improved purple-top yellow, strongly recommended it in preference to the yellow bullock, where not exposed to frost. Of the swedes, Skirving's purple-topped clearly produce the heaviest crops. Of the white varieties, the hardy green, though well thought of, does not maintain its former predominance, Pomeranian white being generally the heaviest.

QUALITIES OF SEED.

Much disappointment again is felt in the use of impure and inferior seed, and it is strongly recommended that some farmers would attempt to raise their own seed from selected bulbs.

MANURE.

The early check in August of the growth, varying according to soil, situation, and propensity to disease, has admitted of fewer well-defined comparisons being drawn from the different manurings than formerly. It seems to the Club to be more and more clearly ascertained, that to farmyard manure alone, in quantities however great, extra manures should always be added, as increasing the weight at a cost far under the value of the extra produce: in fact, that no turnips should now be sown, on land under ordinary rotation, without extra manure; and several members remarked, that with the addition of guano, the crop did often as well with dung little decomposed as with that more thoroughly rotten.

The Club are also more impressed with the opinion that bones, either ground or dissolved, should in most cases, especially with swedes, be used with guano and lighter manures. The practice of

home-dissolving bones is extending, as more economical and satisfactory; and several members decidedly, from experiments, advise the use of them, mixed with guano, as the cheapest and surest mode of raising turnips on the ordinary soils of the district. Some members, however, of extensive experience, state that on their gravelly and quicker-acting soils, they prefer and use ground bones in preference to dissolved, as carrying out the growth later in the season, and giving much more permanent fertility to the soil. It was admitted at all hands that the latter effect was invariable.

While the Club, observing the yearly extending use of extra manures in the district, are sensible that a great deal more may be profitably applied, and see that were guano lessened 30 to 40 per cent in price, the increase of green crops in extent would soon be very large, it need scarcely be necessary to repeat, that care and attention in increasing the farmyard manure is still of the first consequence, in insuring productive after-crops, and more especially good grass.

As stated in former Reports, this Table and remarks will be of more interest to the farmers of the district, acquainted with the localities and soils of each farm, than it can be to strangers. But for the information of those unconnected with Annandale, it may be proper to mention that the district in which these weighings are made extends for about 25 miles in length along the valley of the Annan, in elevations from 100 to 800 feet above sea-level, the farms inspected being mostly between 200 and 400 feet, though this year several of the best crops are from 600 to 700 feet.

It may also be mentioned that the Club, at previous meetings, keeping in view the necessity there is, from the continued failure of the potatoes, of increasing the varieties of green crop, have requested several farmers, in different localities and elevations in the district, to make in 1853 correct experiments in growth of mangold-wurtzel in comparison with turnips, for the information of the Club and the farmers in the district generally. It will be recollected that this was specially brought into notice at the late Dumfries Show, by the Duke of Buccleuch, among other excellent remarks made by his Grace on Dumfriesshire farming.

REPORT BY THE KELSO FARMERS' CLUB relative to Experiments made, under the direction of the Club, by several of its Members, for the purpose of endeavouring to ascertain the relative value of the various kinds of Guano, and some other substances, as Manure for a Turnip Crop.*

THE Club, after some discussion at its Monthly Meeting in April last, relative to the comparative value of different varieties of guano, resolved, previous to the season of sowing turnips last summer, to test this matter by experiment, not only as to the comparative efficiency of these manures on the turnip crop, but also of some other of the lighter foreign substances in ordinary use, applied solely and distinctively. The following specific manures, it was accordingly agreed, should be purchased by the Club, and distributed among such members as were willing to undertake the proposed experiments; and to secure accuracy and perfect similarity in the nature of the substances used, these were obtained from one house. The manures were directed to be applied in quantities estimated according to their equivalent in money value. The regulations were as under:—

1. That the extent of land for each manure experimented upon, shall not be less than one-fourth of an imperial acre, occupying not less than 4 drills, 28 inches apart.

2. That all the manures shall be applied, if possible, in the same day, or if not, to be for Swedish turnips from the 15th to the 23d of May; and for common, in the first week of June.

3. All the manures to be ordered by the Club; but each experimenter to pay for what he gets.

4. The seed to be ordered in the same way.

5. The experiments to be made with the following substances—viz.:

		Swedish turnips, at cost of 38s. per imp. acre.			Common turnips, at cost of 28s. 6d. per imp. acre.		
		cwt.	qrs.	lb.	cwt.	qrs.	lb.
1.	Peruvian guano	4	0	0	3	0	0
2.	Bolivian do.	4	1	12	3	1	0
3.	Saldanha Bay do.	6	1	8	4	3	0
4.	Shark's Bay do..	6	1	8	4	2	24
5.	Chilian do.	5	0	3	3	3	8
6.	Sulphate of ammonia	2	1	8	1	2	24
7.	Ground bones	5	0	8	3	3	16
8.	Dissolved bones	4	2	0	3	1	12
9.	Ground bones	2	1	24	1	3	12
	Sulphate of ammonia	1	0	20	0	3	16
10.	Saldanha Bay guano	2	0	8	1	2	8
	Sulphate of ammonia	1	2	8	0	4	20
11.	Dung well prepared, 16 loads or yards per imperial acre...						

* Communicated by John Dudgeon, Esq., Spylaw, President of the Kelso Farmers' Club. The Directors, in thanking the Club for the Report, would impress on other local agricultural associations the importance of such communications being made to the Society, and the means afforded by the *Transactions* of recording them, for after reference.

The gentlemen after-mentioned, occupying land of various qualities and in different localities of the district, kindly consented to conduct the experiments proposed, and in carrying out these strictly to conform in all respects to the regulations recommended by the Club.*

An examination, in most instances, of the crops on the ground when matured, was undertaken by a committee appointed for the purpose, and the Club has every reason to believe that its directions were faithfully attended to. It is unnecessary to give the observations of this committee as to the appearance of the different crops on the ground, and of the estimated value attempted in some cases to be then made, as the more reliable test of comparative weight remained to be instituted. The gentlemen who undertook the experiments were directed to weigh a portion of the turnips produced from each variety of the manures tried, according to the facilities they possessed for this purpose, and to report the results, with any observations otherwise which might occur to them. The centre drills of each lot, from end to end of the land, were accordingly submitted to this test; and the Tables following show the results of crops grown as reported.

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* No Saldanha Bay guano being at the time to be had by the party to whom the order was given to supply the above manures, Letham Island guano was substituted.

[SWEDISH TURNIPS,

SWEDISH TURNIPS, RATE PER IMPERIAL ACRE.

	Mr Allan, Fogorig, Parish of Fogo, Berwickshire.			Mr Purves, Burnfoot, Parish of Linton, Roxburghshire.			Mr Dove, Newton of Eccles, Parish of Eccles, Berwickshire.			Mr Johnston, Crailing Hall, Parish of Jedburgh, Roxburghshire.			Mr Turnbull, Lempitlaw East-field, parish of Sprouston, Roxburghshire.			Mr Munro, Fairnington, Parish of Roxburgh, Roxburghshire.			Mr Rutherford, Crailing Tofts, Parish of Crailing, Roxburghshire.			Mr Johnston, Girrick, Parish of Nenthorn, Berwickshire.		
	Tns.	Cwt.	St.	Tns.	Cwt.	St.	Tns.	Cwt.	St.	Tns.	Cwt.	St.	Tns.	Cwt.	St.	Tns.	Cwt.	St.	Tns.	Cwt.	St.	Tns.	Cwt.	St.
1. Peruvian Guano.........	24	7	6	19	18	2	16	19	0	15	6	3½	24	5	6	18	9	0	18	11	0	21	15	0
2. Bolivian Guano	22	19	4	19	9	2	15	1	0	14	19	4	21	1	3	18	8	0	19	5	0	20	2	0
3. Letham Island	23	6	4	19	11	4	15	16	0	14	9	2½	25	18	2	17	0	0	19	0	2	19	8	0
4. Sharks' Bay Guano ...	23	13	5	19	7	0	15	10	0	14	8	3	23	9	7	16	4	0	19	5	4	20	11	0
5. Chilian Guano............	24	0	6	19	7	6	14	6	5½	15	17	0	20	16	4½	17	8	0	20	0	6	21	12	0½
6. Sulphate of Ammonia...	21	4	1	19	0	2	13	10	5	8	12	4	15	10	0	7	14	0	13	6	2	19	5	0
7. Ground Bones...........	23	13	5	17	0	0	14	12	0	14	11	6	19	17	2	16	2	0	18	11	0	21	9	0½
8. Dissolved Bones.........	22	5	3	19	13	0	15	19	1	13	18	2	20	2	1	18	12	0	20	5	2	22	8	0
9. Ground Bones, and Sulphate of Ammonia	21	11	2	17	8	0	13	17	0	15	14	3	19	12	3	15	6	0	20	6	6	20	12	0½
10. Letham Island, and Sulphate of Ammonia	21	11	2	18	0	0	14	5	0	15	9	4	19	5	2	18	4	0	18	6	0	20	5	0
11. Dung	24	7	6	19	7	0	17	2	0	0	0	0	24	14	12	0	0	0	20	7	0	0	0	0

COMMON WHITE GLOBE, RATE PER IMPERIAL ACRE.

	Mr Dove, Eccles Newton, Parish of Eccles, Berwickshire.			Mr Roberton, Hoselaw, Parish of Linton, Roxburghshire.			Mr Munro, Fairnington, Parish of Roxburgh, Roxburghshire.			Mr Hardie, Harrietfield, Parish of Nenthorn, Berwickshire.			Mr Oliver, Hardacres, Parish of Eccles, Berwickshire.	Mr Nisbet, Rumbleton, Parish of Gordon, Berwickshire.
	Tons.	Cwt.	St.	Tons.	Cwt.	St.	Tons.	Cwt.	St.	Tons.	Cwt.	St.		
1. Peruvian Guano	15	7	4	24	16	$4\frac{1}{2}$	13	8	0	17	13	2	Not weighed.	Not weighed.
2. Bolivian Guano	17	0	0	23	0	$4\frac{1}{2}$	12	18	0	17	17	6		
3. Letham Island Guano	17	10	2	26	11	$1\frac{1}{3}$	14	4	0	20	12	4		
4. Sharks' Bay Guano	16	16	2	25	0	$2\frac{1}{2}$	12	14	0	21	12	0		
5. Chilian Guano	17	10	5	20	19	2	14	2	0	21	3	0		
6. Sulphate of Ammonia	8	4	5	22	6	$2\frac{1}{3}$	11	16	0	4	7	6		
7. Ground Bones	13	18	6	21	4	$4\frac{1}{3}$	11	10	0	15	3	0		
8. Dissolved Bones	17	0	0	24	13	2	12	2	0	17	10	2		
9. Ground Bones, and Sulphate of Ammonia	14	10	0	23	15	$1\frac{1}{2}$	13	16	0	11	13	2		
10. Letham Island, and Sulphate of Ammonia	11	18	$0\frac{1}{3}$	22	2	4	11	4	0	11	1	2		
11. Dung	18	3	6	23	15	2	0	0	0	20	7	2		

The following additional observations were communicated to the Secretary of the Club:—

I. Mr Allan remarked that all the eleven portions of ground were sown on the 22d of May, on a clay loam after a crop of oats. The land had been well limed four years ago, and was in good condition.

On the 9th June, weather favourable, the turnips were generally through the ground where dry and fine.

On the 3d July, all through the ground, not quite ready for singling.

On the 9th July, singled the whole of the eleven portions of ground.

Mr Allan made the following observations as to the appearance of the crop:—

No. 1. On the 9th June, appeared good; 3d July, best of the whole.

No. 2. On the 9th June, appeared next to No. 1; 3d July, next best still.

No. 3. On the 9th June, next to the last two; 3d July, not quite so good as No. 4.

No. 4. On the 9th June, so so; and on 3d July good, like No. 8.

No. 5. On the 9th June, so so; 3d July, better than No. 6.

No. 6. On the 9th June, not so good as No. 5; on 3d July, a shade better than No. 7.

No. 7. On the 9th June, so so; on 3d July, a great deal worse than No. 8, a shade better than No. 9.

No. 8. On the 9th June, equal to the Peruvian; and on 3d July, a great deal better than Nos. 9, 10, and 11.

No. 9. On the 9th June, goodish; on 3d July, a shade better than No. 10.

No. 10. On the 9th June, next worse to the dunged; 3d July, worst of the whole eleven experiments.

No. 11. On the 9th June, worst of all; 3d July, better than No. 10.

II. Mr Purves remarked that the turnips were all sown in the space of two hours on the 1st day of June last, rather late for Swedish turnips; but the field being of clay soil, it could not be sooner sown in a good state. The weather was very warm after sowing, and the turnips brairded in three days. They were all singled in three weeks and four days after sowing. The Peruvian guano came first away, and looked to appearance all the summer to be the best crop. There was not much difference in the appearance of the rest of the crop all the season, except the portion No. 6, done with sulphate of ammonia, which was inferior looking; but from the 1st of November, that portion made rapid progress, and the shaws were strongest of any when the turnips were lifted on the 2d of December. The average weight of these eleven manures stands 18 tons, 19 cwt., 5 st. per acre. The field contained about twenty acres, and one-half of it was sown with Swedish, and the other half with Dale's Hybrid seed. When farmyard manure was used, it was at the rate of 20 loads per acre, and the weight of these turnips so manured was found to average 22 tons, 13 cwt. an acre, being 3 tons, 13 cwt., 3 st. more weight than those grown

by the guanos, &c. above mentioned. Dale's Hybrid were at the rate of 25 tons per acre; and these observations go to show that it is bad economy to be sparing in putting on manures, when the small quantity of four cart-loads produced 3 tons 13 cwt. 3 st. more weight than the average of the other manures, and 3 tons 6 cwt. above the dung at 16 loads per acre.

III. Mr Oliver remarked that all the turnips were sown on the 8th of June, and were all equally well brairded on the 20th, and all thinned out on the 15th of July; No. 1 was rather the strongest, and No. 6 rather behind the others.

Began to pull on 16th October, taking four drills of each kind, and leaving three, which were all inspected on the 4th of November in the presence of Mr Nisbet of Lambden, and Mr Hogarth, Eccles Tofts, when the quality of turnips sown with the ten different kinds of guanos, &c., appeared so equal as to render it difficult to assign to any one a superiority, though No. 1 rather had the advantage; and about 12 yards at the ends of each drill that were heavily dunged, still better, but not much. In Nos. 9 and 10 there did appear to be a good many decayed turnips, few amongst the other kinds, while the crop was not perceptibly heavier.

IV. Mr Rutherford remarked that, in addition to those in the Table, Saldanha Bay guano was applied by him, at the cost of 30s. per acre, being 5 cwt., and that the Swedish turnips grown therewith yielded at the rate of 20 tons 4 cwt. 2 stone; that nine cart-loads of dung, and 2 cwt. of this guano, yielded 21 tons 17 cwt.; and that having cut up six turnips from each lot, with a view of proving soundness, he found their qualities as under:—

No. 1. Bad quality.
No. 2. Rather better.
No. 3. Bad.
No. 4. Nearly sound.
No. 5. Bad.
Nos. 6 and 7. Good.
Nos. 8 and 9. Very bad.
Nos. 10, 11, and the two additional experiments with Saldanha Bay guano, all good.

V. Mr Nisbet remarked that the turnips were sown on the 27th day of May, on very inferior land, worth about 10s. per acre to rent, and were examined on the 24th of June by Messrs Henderson, when they reported as follows:—

No. 11. Best.
No. 8. Nearly as good.
No. 5. Next to No. 8.
No. 4. Average of the whole.
Nos. 1, 2, 3, 9, and 10. Equal, but inferior to the above Nos.
No. 7. Bad.
No. 6. Worst of the whole.

The turnips were again examined by the Messrs Henderson, on

the 19th of October, and, from the dry state of the season, it appeared the crop had been early attacked by finger-and-toe, and were consequently a partial failure, and they reported as follows:—

No. 11. Best.
No. 1. Next best.
No. 2. Nearly as good as No. 1.
No. 10. Inferior to No. 2.
Nos. 8 and 9. Equal, but inferior to No. 10
Nos. 3, 4, and 5. Nearly equal.
No. 7. Bad.
No. 6. Worst of the whole.

VI. Mr Munro remarked that the land sown with Swedish turnips by him on the 26th of May was limed last year, and in pretty good condition.

Nos. 1, 2, 3, 4, and 5, were singled on the 30th of June—the remaining Nos. on the 4th of July.

The common turnips were sown by him on light sandy land in very poor condition.

VII. Mr Dove remarked that the Swedish turnips were sown on the 25th of May, on a clay soil, drained every 30 feet, and limed sixteen years ago. Each lot consisted of four drills, all very uniform in quality. One half the length of drills was well reduced and in good order for sowing; the other half was not, having been caught with a heavy rain when newly cross-ploughed, and, as the weather continued showery till near the time of sowing, it could not be got into good order again—and the turnips on the latter half were 3 tons per acre less than the half which was worked in good order. All the lots brairded well, and no difference could be observed in any of them till the 20th of June, when, after two or three rainy days, No. 6 had fallen behind the others; noted their appearance on the 29th of June, four days before thinning them:—

Nos. 1, 2, 3, 4, and 5. Were nearly equally good.
No. 6. About five days behind.
Nos. 7 and 8. Good.
Nos. 9 and 10. Not quite so good.
No. 11. Good.

The turnips were again examined on the 9th of July—

Nos 1, 2, 3, 4, and 5. Still nearly equal.
No. 6. Worst.
No. 7. Very little better than No. 6.
No. 8. Equal to the first five Nos.
Nos. 9 and 10. Not so good.
No. 11. Good.

Until the month of September they maintained nearly the same relative positions, and then Nos. 6 and 7 appeared to be making up their lost ground, and at the time of lifting were as strong in the shaw as any of them. Lifted and weighed the two centre drills of each lot on the 25th November.

The common turnips were sown on the 15th of June, on a light soil of inferior quality, upon a moorland subsoil, drained every 30 feet, limed fifteen years ago. They were a week later in being sown than was intended, the weather having been too windy for sowing the light manures. Immediately after sowing there was a continuation of wet weather for some time. They all brairded pretty equally except No. 6, which did not braird at all till the weather got dry. Noted their appearance on the 9th of July, a week before thinning them :—

Nos. 1, 2, 3, 4, and 5. Looking well.
No. 6. Just brairded, looking very ill.
No. 7. Very little better than No. 6.
No. 8. Looking well.
Nos. 9 and 10. Middling.
No. 11. Looking well.

Thinned Nos. 1, 2, 3, 4, 5, 8, and 11 on the same day; Nos. 7, 10, and 11, five days after; and No. 6 a week later.

On the 25th July—

No. 1. Best.
Nos. 2, 3, 4, and 5. Nearly as good.
No. 6. Very bad.
No. 7. Very middling.
No. 8. Good.
Nos. 9 and 10. Middling.
No. 11. Good.

No. 1 maintained its appearance of superiority over the others all the summer; but the whole crop in the field ran too much to shaw for such weak soil, and after the shaw fell it was found deficient.

Summary.—On referring to the Table of results, 1st, as regards the experiment with Swedish turnips, it will be found that it is almost impossible to classify distinctly the relative merits of the *whole* of the different guanos, the effects being so dissimilar on different farms. The influence of variety of soil, as accounting for this dissimilarity, might be a useful subject of investigation in the laboratory. In one respect only, may there be said to be an almost perfect uniformity of result — viz., that following the application of sulphate of ammonia, which, in every instance but one, gave the lowest return. Farmyard manure also, where used, will be found to take nearly uniformly the first or second place. Among the guanos the Peruvian variety decidedly excels and preserves the highest place in all but two instances. It is not so easy to say, where the results become more varied, which is entitled to the next place in merit; but, upon the whole, the Chilian seems to preserve a good position, and in two instances is first among the guanos. Letham Island has also in one instance a first place, but in four occasions it is below Bolivian, while we find Shark's Bay five times indicating a superiority to the former. In two instances we find dissolved bones superior to

all the guanos; while, again, twice it is surpassed by them all. Ground bones in general show a marked inferiority. Generally, it will be observed, the mixed ingredients stand low, only in two instances preserving a superior place.

Again, on examining the Table in reference to the results of the experiments, as to the effects of the different varieties of guano in the production of "common white-globe" turnip, we find Peruvian, which is in general so decidedly superior in the growth of Swedes, preserving here, at best, only a medium position, and in two instances inferior to all the others. Letham Island, in three instances out of the four, stands first, and in every case ranks superior to Peruvian. Next in merit seems to be Shark's Bay and Chilian, although the latter stands lowest in one instance, where, it will be observed, the general produce is the highest of all that has been reported. Excluding farmyard manure, as in these experiments somewhat more varied in its effects, dissolved bones seem to take rank next to guano; and sulphate of ammonia singly, or in combination, we again find always inferior, excepting in the instance to which we have just alluded, when the produce is so *generally* high, as to lead to the inference that the previous condition of the land must have been such as to render it somewhat less dependent upon the last applications.

PREMIUMS AWARDED BY THE SOCIETY IN 1852.

CLASS I.—REPORTS.

1. The gold medal to James Cowie, Mains of Haulkerton, Kincardineshire, for a plan and specification of a steading and offices, adapted for a farm of mixed husbandry, containing above 200 acres under a regular rotation.

2. The gold medal to James Cowie, Mains of Haulkerton, for a plan and specification of a steading and offices, adapted for a farm of mixed husbandry, worked by two pair of horses under a regular rotation.

3. The gold medal to Duncan Forbes, Culloden, Inverness-shire, for a report of improvement of waste land on the estate of Culloden.

4. The gold medal to James Melvin, Bonnington, Ratho, Mid-Lothian, for a report on the manurial value of turnip and linseed cake.

5. The gold medal to John Lockhart Morton, land-agent, Edinburgh, for a report on the application of liquid manure.

6. The gold medal to John Lockhart Morton, land-agent, Edinburgh, for a report on the formation and early management of plantations.

7. The gold medal to James Porter, land-steward, Monymusk, Aberdeenshire, for a report on draining.

8. The gold medal to James Porter, Monymusk, for a report on compost heaps.

9. The gold medal to Andrew Templeton, Clandeboye, Holywood, Ireland, for a report on the best modes of housing, and on the comparative advantages of soiling and of pasturing cattle.

10. The gold medal to Alexander Thomson of Banchory, Aberdeenshire, for a report of improvement of waste land on the estate of Banchory.

11. The gold medal to John Wilson, Edington Mains, Berwickshire, for a report on the use of the grubber.

12. The medium gold medal to William Adam of Ranna, advocate, Aberdeen, for a report on soiling and pasturing cattle.

13. The medium gold medal to Henry Anderson, jun., Ballynacree House, Ballymoney, Ireland, for a report on the employment of peat in burning clay pipes and tiles.

14. The medium gold medal to Robert Boyle, Drongan Pottery, Ayr, for a report on top-dressing grass with guano.

15. The medium gold medal to Thomas Ferguson, Ashmore, Perthshire, for a report of improvement of waste land.

16. The silver medal to Kennedy M'Nab, Millburn Cottage, Inverness, for a report on the cottage accommodation of parts of the counties of Nairn, Inverness, Ross, and Cromarty.

17. The silver medal to James Young, land and wood surveyor, Perth, for a report on arboriculture.

Class II. — LIVE STOCK — DISTRICT COMPETITIONS.

I. CATTLE.

1. *The District of Huntly.*

Honorary Premium.

Bulls.		Her Grace the Duchess of Gordon, Huntly Lodge,	Silver Medal.

Money Premiums.

Bulls.	1.	Andrew Longmore, Rettie, Banff,	L.10 0 0
	2.	William Lawson, Lessendrum, Huntly,	5 0 0
Heifers.	1.	Robert Cran, Scurdargue, Rhynie,	5 0 0
	2.	Charles Bruce, Broadland, Huntly,	3 0 0

2. *The Northern District of Kirkcudbright.*

Honorary Premium.

Bulls.		James Alexander of Currydow, Castle-Douglas,	Silver Medal.

Money Premiums.

Bulls.	1.	Alexander M'Turk, Barlae, Castle-Douglas,	L.10 0 0
	2.	John Shaw, Parkrobin, New Galloway,	5 0 0
Heifers.	1.*	John Sinclair, Trochiehouse, New Galloway,	2 10 0
	2.*	Alexander M'Cormick, Grennan, Castle-Douglas,	1 10 0

3. *The County of Inverness.*

Bulls.	1.	George France, Lovat, Bogroy,	L.10 0 0
	2.	Hugh Fraser, Balloch of Culloden, Inverness,	5 0 0

4. *The Counties of Ross and Cromarty.*

Honorary Premium.

Bulls.		Alexander Matheson of Ardross, M.P.,	Silver Medal.

Money Premiums.

Bulls.	1.	Alexander Allan, Drummond, Evanton,	L.10 0 0
	2.	James Dudgeon, Fodderty, Dingwall,	5 0 0

* Half premiums awarded, the number of lots being under six.

II. DRAUGHT HORSES.

The County of Caithness.

2 Year old Colts.	John Swanson, Ham, Thurso,	L.8 0 0
1 Year old Colts.	John Waters, Carsgo, Thurso,	5 0 0

III. SHEEP.

Leicester Breed.

1. *The District of Buchan.*

Tups.*	John Ferguson, Coynach, Mintlaw,	L.2 10 0
Ewes.*	John Ferguson, Coynach,	2 10 0

2. *The Counties of Edinburgh and Haddington.*

Tups.	Thomas Dickinson, Magdaline Hall, St Boswells,	L.5 0 0
Shearling Tups.	James Douglas, Athelstaneford, Drem,	5 0 0
Ewes.	William Tod, Elphinstone Tower, Tranent,	5 0 0
Gimmers.	James Douglas, Athelstaneford,	4 0 0

Cheviot Breed.

1. *The District of Selkirk.*

Tups.	John Moffat, Craik, Langholm,	L.5 0 0
Shearling Tups.	John Moffat, do. do,,	5 0 0
Ewes.	John Moffat, do. do.,	5 0 0
Gimmers.	John Moffat, do. do.,	4 0 0

2. *The County of Roxburgh.*

Honorary Premium.

Tups.	Thomas Elliot, Hindhope, Jedburgh,	Silver Medal.

Money Premiums.

Tups.	Thomas Elliot, Hindhope,	L.5 0 0
Shearling Tups.	Mrs Major Oliver of Bush, Jedburgh,	5 0 0
Ewes.*	Thomas Elliot, Hindhope,	2 10 0
Gimmers.*	Thomas Elliot, do.,	2 0 0

Blackfaced Breed.

1. *The District of Argyll.*

Tups.	James M'Kechnie, Arinechtan, Lochgilphead—Class I., †	L.5 0 0
Gimmers.	Alex. Campbell of Auchindarroch—Class I., †	4 0 0

2. *The District of Cowal.*

Tups.	Walter Buchanan, Stronafian—Class I.,†	L.5 0 0
Tups.	Duncan Turner, Corachaine—Class II.,‡	5 0 0
Gimmers.	A. Campbell of Glendaruel—Class I.,†	4 0 0
Gimmers.	John and Archibald M'Nicol, Strondivan—Class II.,‡	4 0 0

* Half premiums awarded, the number of lots being under six.
† Class I., Proprietors or tenants paying more than L.150 of rent.
‡ Class II., Tenants paying under L.150 of rent.

SHEEP SHEARING.

1. Thomas Rutherford, Lamberton, Berwickshire,	.	Silver Medal.
2. George Laidlaw, Mervinslaw, Roxburghshire,	.	Silver Medal.

IV. SWINE.

Parish of Inveraven, &c.

HONORARY PREMIUM.

BOARS. Sir George Macpherson Grant of Ballindalloch, Bart.—Silver Medal.

MONEY PREMIUMS.

BOARS.	1. Alexander Robertson, Mill of Tomore,	L.4	0	0
"	2. Robert Hay, Raechlerich,	2	0	0
SOWS.	1. George Smith, Minmore,	2	0	0
"	2. Donald Gordon, Deskie,	1	5	0
"	3. William Robertson, Burnside,	0	15	0

CLASS III.—DAIRY PRODUCE.

The County of Renfrew.

I. BUTTER.

HONORARY PREMIUM.

Robert Pollock of North Walton—Silver Medal.

MONEY PREMIUMS.

1. John M'Nair, Meikleriggs, Paisley,	L.3	0	0
2. William Clark, Burnside, Mearns,	2	0	0
3. William Kerr, Carse, Lochwinnoch,	1	0	0

II. CHEESE.

1. Andrew Gemmell, Caplay, Neilston,	L.3	0	0
2. William Kerr, Barrodger, Lochwinnoch,	2	0	0
3. Hugh White, Barnbrock, Kilbarchan,	1	0	0

CLASS IV.—CROPS AND CULTURE.

I. SEEDS.

The Silver Medal has been awarded to the following parties:—

1. *The County of Renfrew.*

1. John Muir, Porterfield, Renfrew, for White Wheat.
2. John Muir, Porterfield, for Sandy Oats.
3. Thomas Glen, Hillhead, Paisley, for Field Beans.
4. Alexander Maclachlan, East Longhaugh, for Potatoes.

2. *The District of Buchan.*

1. Robert Milne, Woodhead of Cairness, Cortes, for Early Barley Oats.
2. Crawford Watson, Netherton of Logie, Petherhead, for Rye Grass.

3. *The County of Haddington.*

1. Alexander Brodie, East Fortune, for April Wheat.
2. Thomas Mitchell Innes of Phantassie, for Chevalier Barley.
3. James Murray, East Barns, for Barley, (Noble's variety.)
4. James Brodie, Linplum, for Potato Oats.
5. Alexander Brodie, East Fortune, for Angus Oats.
6. John Dods, Pathhead, for Sandy Oats.
7. John Brown Wright, Hedderwick Hill, Dunbar, for Beans.

4. *The District of Wester Ross.*

1. Hugh Innes Cameron, Dingwall, for White Wheat.
2. Hugh Innes Cameron, do., for Sandy Oats.
3. John Mackenzie, Kinnettas, Dingwall, for Common Barley.

5. The County of Inverness.

1. Lord Lovat, Beaufort Castle, Beauly, for Chevalier Barley.
2. Angus Macleod, Castle Leather, Inverness, for Rye-Grass Seed.
3. Angus Macleod, do., for late Angus Oats.
4. Angus Macdonald of Glenalladale, for White Wheat.

II. TURNIP SEED.

District—The County of Aberdeen.

The Gold Medal to George Milne of Kinaldie, for Purple-Top Yellow-Field Turnip-Seed.

III. GREEN CROPS ON SMALL POSSESSIONS.

1. The Parishes of Kenmore and Killin.

1. Donald M'Dougall, Miltown of Ardtalanaig,	L.3	0	0
2. John M'Laren, Machium,	2	10	0
3. Peter Stewart, Craganester,	1	10	0
4. Archibald Walker, Blarmore,	1	0	0

2. The Quoad Sacra Parish of New Pitsligo.

1. William Laing, Cairnywhing,	L.3	0	0
2. Peter Guthrie, Tillinamolt,	2	10	0
3. William Milne, do.,	1	10	0
4. James Benge, Cairnywhing,	1	0	0

IV. MEDALS IN AID OF PREMIUMS GIVEN BY LOCAL SOCIETIES.

1. District of Carrick.

1. Robert Allan, Milton, Maybole, for Best Managed Farm—1850.
2. James Dunlop, Merkland, Kirkmichael, for Best Managed Farm—1851.
3. Charles Stewart, Truuew, do., for Best Managed Farm—1852.

2. District of Bute.

1. Alexander Duncan, Birgadale, Knock, for Best Kept Dairy.
2. Robert M'Alister, Mid Ascog, for Best Managed Green Crop.

3. District of Breadalbane.

1. Robert Peter, Urlar, for Best Managed Green Crop.
2. Donald M'Arthur, Acharn, for Best Kept Dunghill.

4. Parish of Dalrymple, Ayrshire.

Robert Allan, Milton, for Best Managed Green Crop.

5. East of Berwickshire.

1. Andrew Common, Blackadder, for Cutting Hedges.
2. John Brown, Ayton Castle, for do.

6. District of Ythanside.

George Milne, Haddo, for best managed Green Crop.

V. PLOUGHING COMPETITIONS.

In the course of the year the Society's Medal was awarded at seventy-two Ploughing Competitions, the details of which are given in a previous part of this volume.

CLASS V.—COTTAGES.

FOR THE BEST KEPT COTTAGES AND GARDENS.

1st Cottage Premium—L.1, 5s., and Medal when 4 Competitors; 2d,—L.1; 3d,—15s. 1st Garden Premium—L.1, 5s., and Medal when 4 Competitors; 2d, 15s.

County of Berwick.

AYTON.—1st Premium and Medal to John Aitken; 2d, William Lauder; 3d, Andrew Renton.

BUNKLE.—1st Premium and Medal to James Dunlop; 2d, —— Thomson; 3d, Robert Trotter.

COCKBURNSPATH.—1st Premium to Misses Thompson; 2d, Mrs Maven; 3d, Jane Kerr. Garden Premium, (L.1) Jane Kerr.

COLDSTREAM.—1st Premium and Medal to William Marshall; 2d, Robert Kerr; 3d, James Ballantine. 1st Garden Premium and Medal to Robert Kerr; 2d, William Rutherford.

EDROM.—1st Premium and Medal to John Thomson; 2d, William Huie; 3d, Peter Johnston. 1st Garden Premium and Medal to Thomas Kinghorn; 2d, James Grossert.

EYEMOUTH.—1st Premium and Medal to John Cleghorn; 2d, John Rae; 3d, Christian Grey. Garden Premium, (L.1) John Owens.

FOULDEN.—1st Premium and Medal to John Slight; 2d, John Jeffrey; 3d, John Spark.

HUTTON.—1st Premium and Medal to Charles Jeffrey; 2d, George Claizie; 3d, Mrs Geggie. 1st Garden Premium and Medal to Mrs Geggie; 2d, Robert Welsh.

LADYKIRK.—1st Premium to Andrew Haswell; 2d, James Cockburn; 3d, John Dippey. Garden Premium, Thomas Bennett.

WHITSOME.—1st Premium and Medal to Joseph Shepherd; 2d, John Renton; 3d, Thomas Fallow.

County of Dumbarton.

BONHILL.—1st Garden Premium and Medal to William Cunningham; 2d, Thomas Ryland; 3d, (10s.) Robert Small.

County of Forfar.

CRAIG.—1st Premium and Medal to James Hunter; 2d, Charles Morris; 3d, John Allan. 1st Garden Premium and Medal to James Birse; 2d, Alexander Thompson.

County of Perth.

MOULIN.—1st Premium and Medal to James Walker; 2d, Donald Robertson; 3d, Peter Macfarlane. Garden Premium (L.1) to Alex. Robertson.

REDGORTON.—1st Premium to Charles Lawson; 2d, Mrs Kidd; 3d, Thomas Garvie.

County of Stirling.

KILLEARN.—1st Premium and Medal to Mrs Scott; 2d, Mrs M'Culloch; 3d, Mrs Aitken. 1st Garden Premium and Medal to William Smith; 2d, Alexander Dunn.

VETERINARY COLLEGE.

The Silver Medal was awarded to each of the following parties:—

1. William Robertson, Dalkeith, for best Examination in Veterinary Medicine and Surgery.
2. John Fisher, Whitehaven, for best Examination in Anatomy and Physiology.
3. James Collins, Birmingham, for best Examination in Chemistry.
4. James Collins, Birmingham, for best Examination in Materia Medica.
5. John Fisher, Whitehaven, for best General Examination.
6. John Bowman, Ebrington, Yorkshire, for best Anatomical Preparations.
7. James Collins, Birmingham, for Essay on Disinfectants.
8. William Robertson, Dalkeith, for Essay on Disinfectants.

PERTH SHOW.

The Premiums awarded at the Perth Show are contained in the *Transactions* for October, and will be paid, along with those now published, on application at the Secretary's office.

All premiums not applied for within two years from the term of payment will be forfeited.

By Order of the Directors.

JN. HALL MAXWELL, *Secretary*.

EDINBURGH, *10th February* 1853.

PROCEEDINGS IN THE LABORATORY.

By Professor ANDERSON, M.D., Chemist to the Highland and Agricultural Society.

Continued from p. 518.

ON THE COMPOSITION OF CASTOR-OIL CAKE.

WITHIN the last year or two, an attempt has been made to introduce the cake obtained in expressing the seeds of the castor-oil plant as a manure, which is deserving attention, both because it is in itself likely to prove a serviceable addition to the list of substances which may be advantageously employed, and because it may lead to the use of many similar substances, which are at present neglected, or thrown aside as refuse.

The castor-oil seed is similar in chemical composition to the other oily seeds. It consists of a mixture of mucilaginous, albuminous, and oily matters; and the former two of these are identical in constitution and general properties with the substances found in linseed and rape cake, while the oil is principally distinguished by its purgative properties. The process employed for expressing the castor-oil is in all respects similar to that used for other seeds, and is sometimes performed with the aid of heat, and sometimes in the cold, in which latter case the oil is said to be cold-drawn. The cake obtained is in the form of ordinary oilcake, but is at once distinguished from it by its colour, and by the large fragments of the husk of the seeds which it contains. It is also much softer, and may be easily broken down with the hand. I have analysed two samples of castor-cake, stated to have been obtained by different processes; and though I have not been informed of the exact nature of these processes, I infer, from the large quantity of oil, that one must have been cold-drawn. The first of the following analyses is that of the sample which I believe the cold-drawn. It is the most complete of the two, and contains a determination

of the amount of oil. In the other analysis this was not done, but there was no doubt on my mind that its quantity was much smaller.

	No. 1.	No. 2.
Water,	8.32	16.31
Oil,	24.32	...
Nitrogen,	3.05	3.35
Ash,	7.22	4.95

The ash contains—

Siliceous matters,	1.96	...
Phosphates,	3.36	2.27
Excess of phosphoric acid,	0.64	...

In order to give a proper idea of the value of this substance as a manure, I shall quote here, for comparison sake, the average composition of rape-cake, as deduced from the analyses contained in a former part of the Transactions:—

Water,	10.68
Oil,	11.10
Nitrogen,	4.63 *
Ash,	7.79

The ash contains—

Siliceous matters,	1.18
Phosphates,	3.87
Excess of phosphoric acid,	0.39

It will be at once seen that there is a close general resemblance between these two substances, although there is no doubt that the castor-cake is inferior to rape-cake; still, I believe that this inferiority is fully counterbalanced by the difference in price, which is such, that, compared with rape-cake, the castor-cake is really a cheap manure. There is only one of its constituents which it contains in larger quantity, and that is the oil. No weight is, however, to be attached to the quantity of oil in a manure. In a substance to be used as a food, it is of very high importance; but so far as we at present know, its value as a manure is extremely problematical. Whale, seal, and other coarse oils have been used as manures, and by some few observers benefits have been derived from their application; but the general experience has not been favourable to their use, nor should we chemically be induced to expect any beneficial effect from them. We have every reason to believe that the oils which are found in plants, are produced there as the result of certain processes which are proceeding within the plant, and there is no evidence to show that any part of it is ever absorbed in the state of oil by the roots when they are presented to them. On the other hand, the oils are extremely

* In the analyses in question, at page 510 of the present volume, a typographical error occurs in the quantity of nitrogen in the average. It should be 4.63 in place of 4.38.

inert substances, and undergo chemical changes very slowly; so that there is no likelihood of their being converted into carbonic acid, or any other substance which may be useful to the plant; and as they contain no nitrogen, and consist only of carbon, hydrogen, and oxygen, they can yield only those elements of which the plant can easily obtain an unlimited supply. I can conceive cases in which the oil might possibly produce some mechanical effect on the soil, but none in which it could act as a *manure*, in the proper sense of the term.

Castor-oil cake has been already used to some extent as a manure, and it may advantageously replace rape-cake, in cases where it is employed, excepting that, to supply the deficient percentage of nitrogen, a larger quantity must be employed. I have not heard the results of any experiments made with castor-oil cake, and should any persons be induced to make a trial of it, it will be desirable that the results should be published. Supplies of the cake may be obtained from Messrs J. and J. Cunningham, Edinburgh.

ON THE USE OF BONE-OIL AND THE AMMONIACAL LIQUOR OF THE IVORY-BLACK MANUFACTORIES AS A MANURE.

I have had occasion recently to examine these substances in an agricultural point of view, and the result of the examination is such as to induce me to call the attention of the farmer to them, as substances deserving of trial as manures. They are obtained during the distillation of bones in iron cylinders for the manufacture of ivory-black, and used formerly to be the source from which all the ammonia of commerce was obtained. Since the manufacture of gas has so greatly extended itself, almost the whole of the ammonia of commerce has been obtained from the gas liquor, which yields it of superior purity; and bone-oil and its ammoniacal liquor have greatly diminished in commercial value, and the manufacturers have often difficulty in getting rid of them. Yet the quantity of ammonia they contain is very large. I have examined a sample of bone-oil, which was found to contain nitrogen equivalent to 10.98 per cent of ammonia, while the ammoniacal liquor contained 12.61 per cent of ammonia. I am not in a condition to assert that all samples of these substances will contain an equally large quantity of ammonia, but in the event of their doing so, they ought to be valuable as manures. The difficulty which would attend their use is, that the ammonia exists in the latter in the state of carbonate, the most volatile of its compounds, and some means would have to be employed to fix it. In the former, on the other hand, a considerable part of the nitrogen is not in the state of ammonia, but in the form of certain compounds, which are also volatile, and which probably would pass with difficulty into the form of ammonia. In the latter case, too, the remainder of the substance consists of a number of oils of most disgusting

odour, similar to those which are found in coal-tar, and might possibly prove injurious to vegetation. Should this prove not to be the case, then I consider these substances to be highly deserving attention, as their value is considerable. If we reckon their value on the principle of calculating the ammonia contained in them at 6d. per pound, as is done with guano and other artificial manures, then the bone-oil must be worth £5, 10s. per ton, and the ammoniacal liquor £6, 6s. Of course, some deduction must be made from these prices, because the ammonia, being in the state of a volatile compound, is less valuable than it would be if fixed; but I believe both of them may be obtained at prices considerably lower than those I have mentioned. Should the attempt be made to employ them, it would, in my opinion, be necessary to experiment with care, and on a small scale, so as to ascertain the best method of using them. It would not be safe to apply them directly to the soil, but they might be advantageously made into a compost with peat, and a quantity of sulphate of magnesia, for the pupose of fixing the ammonia. If this compost were ploughed in some little time before the crop is sown, I conceive the prospects of success would be greatest.

I do not venture to speak positively here as to the use of these substances, as we know too little about the effects of the oils, and other matters existing in them along with the ammonia. We have enough information to show us that they must not be rashly employed, but I consider it probable that, if they be properly composted with a sufficiently large quantity of peat or other matters, so that they may not be applied in too concentrated a state, that good effects may be derived from them.

ON THE COMPOSITION OF THE FLAX-LIQUOR OBTAINED BY WATT'S PATENT PROCESS FOR PREPARING FLAX.

In the number of the Transactions for October 1851, I have given an analysis of the liquor obtained in steeping flax by Schenk's process. Since that time another process has been patented by Mr Watt of Glasgow, which yields a liquor of greater value than Schenk's, and which would be of some agricultural value, not merely as a manure, but as a food for animals.

In Watt's process, the flax-straw, in place of being steeped in warm water for a considerable period, as in Schenk's process, is exposed to a current of steam, which condenses in, trickles down through, and moistens the flax. After exposure to the steam for a comparatively short time, the flax has become perfectly soft, and being then put through the ordinary manipulations, yields a fibre of finer quality than can be obtained by the old processes from the same straw. In the bottom of the steaming apparatus a quantity of a thick mucilaginous fluid collects. This liquor is quite sweet

to the taste, and has no smell, nor shows any putrescence. An imperial gallon was found to contain—

Organic matter, ...	723.5 grains.
Inorganic matter, ...	357.5 „
Total, ...	1081.0

The inorganic matter contained 17 grains of phosphates, and the organic matter 14.7 grains of nitrogen, equivalent to 93.3 grains of protein compounds.

This substance is much richer in solid ingredients than the liquor of Schenk's process, which I found to contain only 291.17 grains of solid matters per gallon, and only 3.19 grains of ammonia. It is also richer than ordinary distillery dreg or wash—at least, it contains a much larger quantity of solid matters than that substance usually contains, though I have seen some valuable specimens of it. I understand that this flax-liquor is greedily swallowed by cattle, and, when the process is introduced, will doubtless prove of use. I understand that the trials of the patent have been of a very favourable nature, and that it is likely to be very extensively adopted.

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PREMIUMS

OFFERED BY

THE HIGHLAND AND AGRICULTURAL SOCIETY OF SCOTLAND,

IN

1852.

CONTENTS.

PRELIMINARY NOTICE.

WHEN the HIGHLAND SOCIETY was instituted in the year 1784, and sanctioned by a Royal Charter in 1787, its objects, comparatively, were few, and their operation limited. They were confined almost exclusively to matters connected with the amelioration of the Highlands of Scotland.

The patronage of certain departments, proper to that part of the country, having been subsequently committed to special Boards of Management, or undertaken by other Associations, several of the earlier objects contemplated by the Society have consequently been abandoned, while the progress of science has led to the adoption of others of a more general character.

The exertions of the Society, instead of being restricted to the improvement of the Highlands, were early extended to that of the Lowlands, and have in both, for nearly seventy years, been directed to the promotion of the science and practice of Agriculture, in all its various branches.

In accordance with this more enlarged sphere of operation, the original name of the Society was altered, under a Royal Charter in 1834, to THE HIGHLAND AND AGRICULTURAL SOCIETY OF SCOTLAND.

The leading purposes contemplated by this Institution, will be sufficiently explicit on perusal of the following pages, and reference to preceding practice.

Premiums are awarded for Reports on every subject connected with the improvement and cultivation of the soil, and the rearing and feeding of stock; encouragement is offered for the improve-

ment of the different breeds of Live Stock, and for the proper management of the Dairy; the growth of Timber is promoted by Premiums for Woods and Plantations; the comforts and convenience of the humbler classes have been attended to by rewarding habits of order and cleanliness, and by stimulating proprietors to improve the construction and increase the accommodation of Cottages. Useful inventions and improvements in Agricultural Machinery and Implements are always patronised and remunerated.

Among the more important measures which have been effected by the Society, are,—

1. The establishment of Cattle Shows and Agricultural Meetings held in different parts of Scotland, at which exhibitors, from all parts of the United Kingdom, have an opportunity of competing for premiums offered for Live Stock, Dairy Produce, and Implements.

2. The establishment of a system of District Shows, instituted for the purposes of improving the Breeds of Stock most suitable for different parts of the country, and of aiding and directing the efforts of Local Agricultural Associations.

3. The advancement of the Veterinary Art by the establishment of a College in Edinburgh, where courses of Lectures are delivered, and Students are instructed in the most approved modes of treating the diseases peculiar to domesticated animals.

4. The appointment of a Chemist and the establishment of a Chemical Department, for the purpose of promoting the application of science to Agriculture. Investigations on subjects of importance are conducted in the Laboratory, and published in the Transactions. Members have the privilege of applying for analyses of Soils, Manures, &c., on favourable terms.

5. The erection of a Museum, adapted to the reception of models of implements and Machines used in the various operations connected with Agriculture. Of these a large collection has been formed. The Museum also contains an assortment of Vegetable

and Mineral Specimens, and Paintings of many of the Animals for which Premiums have been awarded.

6. The periodical publication of the Transactions, which comprehend the proceedings in the Laboratory, the most interesting and important of the Reports, and other communications addressed to the Society. The Transactions are published by Messrs BLACKWOOD and SONS, Edinburgh, simultaneously with the Quarterly Journal of Agriculture.

7. The establishment of Monthly Meetings in the Museum for the discussion of Agricultural subjects.

Though not now in receipt of any public grant, the Society is bound to acknowledge the pecuniary assistance which it has at different periods received from Government, and the countenance and support which have ever been extended to it, by means of which, its efforts for disseminating the spirit of improvement throughout Scotland have been invigorated.

CONSTITUTION AND ESTABLISHMENT.

The whole affairs of THE HIGHLAND AND AGRICULTURAL SOCIETY are conducted under the sanction and control of a Royal Charter, which authorises the enactment of Bye-Laws.

The Office-Bearers consist of a President, four Vice-Presidents, ten Extraordinary, and thirty Ordinary Directors, a Treasurer, and an Honorary and Acting Secretary.

The proceedings of the Directors are reported to Half-yearly General Meetings of the Society, one of which is, by the Charter, appointed to be held on the second Tuesday of January, and the other on such day in the months of June or July as the Directors may fix.

New Members are admitted at either of these General Meetings by Ballot. The ordinary subscription is £1, 3s. 6d. annually, which may be redeemed by one payment varying from £12, 12s. to £7, 1s. Tenant Farmers, Members of any local Society, are admitted on a subscription of ten shillings annually, or £5, 5s. for life.

The Premiums awarded by the Society are payable after the 10th February, for the preceding year. Orders, payable at the Royal Bank of Scotland, will be delivered at the Society's Hall, upon the receipts of the parties to whom the Premiums have been adjudged being presented; or the parties may transmit, through any Bank, stamped receipts, addressed to the Secretary, if done without expense to the Society. The receipt must specify distinctly the Premium in discharge of which it is sent.

Premiums not applied for within two years from the term of payment, will be forfeited.

All communications are to be addressed to the Secretary of the Society, 6 Albyn Place, Edinburgh.

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PREMIUMS.

GENERAL REGULATIONS FOR COMPETITORS.

All Reports must be written in a distinct and legible hand, and on one side only of the paper; the number and subject of Premium for which they are in Competition must be stated; they must bear a distinguishing motto, and be accompanied by a sealed letter similarly distinguished, and containing the name and address of the Reporter.

None of the sealed letters, except those relative to Reports found entitled to at least one-half of the Premium offered, shall be opened without the Author's consent.

Reports for which a Premium, or one-half of it, has been awarded, become the property of the Society, and cannot be published, in whole or in part, nor circulated in any manner, without the consent of the Directors. All other papers will be returned to their Authors if applied for within twelve months.

Models accompanying communications on Agricultural Machinery, for which Premiums have been awarded, become the property of the Society, a reasonable sum being allowed to the Inventor for the expense of construction.

When a Report is unsatisfactory, the Society is not bound to give the reward offered; and power is reserved of awarding such part only of a Premium as the claim may be adjudged to deserve.

All Reports must be of a practical character, containing the results of the writer's own observations or experiment. Papers compiled from books will not be rewarded.

The New or Imperial Standards are alone to be referred to. The decisions of the Board of Directors, confirmed by the Society, are final and conclusive, as to all Premiums, whether offered for Reports, or at General or District Shows, and it shall not be competent to raise any question or appeal touching such decisions before any other tribunal.

Reports, or Communications, on subjects for which Premiums have in former years been offered, will still be received, although the subjects may now be discontinued on the list, and honorary awards will be given, when the communications appear to merit them.

CLASS I.

REPORTS.

§ 1. ON SUBJECTS CONNECTED WITH THE SCIENCE AND PRACTICE OF AGRICULTURE.

1. DRAINING.

For an approved Report on the comparative results of Draining at different depths and distances—The Gold Medal, or Ten Sovereigns.

The Report must state full particulars as to the dimensions of the Drains—the distance between each—the materials used—the expense of construction—the nature of the soil and subsoil—and the results obtained.

Reports to be lodged by 1st November 1852.

2. DEEP PLOUGHING.

For an approved Report on the comparative results obtained by the following modes of Ploughing:—1*st*, By the Common Plough, with a furrow not less than eight inches; 2*d*, By the Common, or the Trench Plough, with a furrow not less than ten inches; 3*d*, By the Subsoil Plough—The Gold Medal, or Ten Sovereigns.

The land operated on must have been thoroughly drained. The Report

must state the nature of the soil and subsoil, and the date, depth, and expense of each ploughing. The extent of land to be not less than one acre for each operation, and on each lot the produce of two separate portions, of not less than 20 poles, to be weighed or measured. In every other respect the whole land to be treated alike.

Reports to be lodged by 1st November 1852.

3. USE OF THE GRUBBER.

For an approved Report on the advantages of the Grubber as a substitute for the Plough—The Gold Medal, or Ten Sovereigns.

The Report must describe the Grubber used, and state the character of the soil and subsoil, the nature of the drainage, the previous tillage of the land, the crops for which it has been prepared by the Grubber, and the results.

Reports to be lodged by 1st November 1852.

4. LIQUID MANURE.

For an approved Report on saving and applying the Liquid Manure of a Farm, and on the circumstances under which it can be beneficially applied—The Gold Medal, or Ten Sovereigns.

The Reporter is required to detail the means employed by him for the above purpose. When tanks are used, the best form and position for them must be stated, as well as the most efficient and economical mode of conveying to them the Liquid from the feeding houses or yards, and the period for which the urine should be kept. The Reporter must also state the best mode of applying it to the land, whether directly, or by mixing it with the manure of the yards, or with other fertilising matters. He is further required to state the results obtained by his experiment. The attention of Reporters is directed to the system followed in Belgium.

Reports to be lodged by 1st November 1852.

5. SPECIAL MANURES.

Fifty Sovereigns will be awarded in such proportions as the Directors may see proper :—

1. For an approved Report of experiments made with different

manures, both separately and mixed in certain proportions, and applied either in solid or fluid form. It is necessary that the land on which the experiments are to be made shall be of as equal quality and exposure as possible, and that, in the preceding rotation, the whole shall have been treated in every manner alike. Each experiment must be made on two ridges, and the results compared with those obtained from two ridges adjoining, which shall have been manured in the ordinary manner of the farm. Each ridge must contain at least a quarter of an acre. These experiments to be made in duplicate thus :—

1	2	Manured in the ordinary manner of the Farm.	3	4	Manured in the ordinary manner of the Farm.	5	6	Manured in the ordinary manner of the Farm.	7	8
5	6		7	8		1	2		3	4

The substances employed may be Guano, Nitrate of Soda, Nitrate of Potash, Sulphate of Soda, Sulphate of Magnesia, Sal-Ammoniac, Sulphate of Ammonia, Soda Ash, Pearl Ash, Kelp, Bones, Soot, Coal-Ashes, or mixtures of these in specified proportions, and any others of known composition, which the experimenters may select. Poudrette or Prepared Night-Soil, and the Ammoniacal liquor of Gas-Works, should also be tried ; and it is particularly recommended that the refuse of Manufactories, such as the Prussiate of Potash,—the refuse of Sugar-Works, Salt-Works, Bleach-Works, and Glue-Manufactories, should be collected and experimented upon.

It is recommended that the experiments should be made with quantities of the different substances corresponding to their chemical equivalents, and that when the refuse of manufactories is employed their composition should, as far as possible, be determined by analysis.

The following is a list of the equivalents of the different salts above mentioned:—

Nitrate of Potash, . .	101·3
Nitrate of Soda, . .	85·4
Sulphate of Potash, . .	87·2
Sulphate of Soda, dry, . .	71·6
Sulphate of Ammonia, . .	80·3
Sal-Ammoniac, . . .	53·5
Carbonate of Potash (Pearl Ash), .	69·2
Carbonate of Soda (Soda Ash), .	53·4
Sulphate of Magnesia, crystallized,	123·8
Sulphate of Lime (Gypsum), .	86·6

In explanation of this list, experimenters should understand, that if they have resolved to make an experiment, say with 101 lb. of nitrate of potash, they ought to contrast it not with 101 lb. of nitrate of soda, but with 85·4 lb., and if any other quantities are fixed upon, their relation can be readily calculated by the rule of three.

When experiments are made with mixtures, the proportions of the several substances must, in all cases be stated.

The quantity by weight, and the cost of the manures employed, as well as the quantity, quality, and marketable value of the crop produced by each, must be accurately ascertained and reported, with the nature and qualities of the soil, its altitude, exposure, drainage, and such other particulars and observations as the Reporter may deem deserving of attention.

The value of the experiments will be enhanced, if accompanied with an analysis or minute description of the soil on which they are made, and means of proving the purity of the manures which were used.

The experimenter is further required to transmit, along with his report, samples of not less than 2 lb. weight, of all the manures employed.

Reports to be lodged by 1st November 1852.

2. For an approved Report, having reference to the experience of two or more preceding seasons, on the effects which any substances, such as those above named, have produced on the soil for a certain period after their application. In all cases, the subsequent produce of the land which had received the particular manure, must be noted carefully by weight or measure, and compared

with that of an equal portion of land immediately adjoining, which had received no special manure.

Reports to be lodged by 1st November 1852.

6. MANURES FOR PEAT MOSS.

For an approved Report on the substances best adapted for fertilising Peat Moss—The Gold Medal, or Ten Sovereigns.

There exist in many parts of the country Mosses which, from their depth and situation, cannot be clayed, or be made capable of bearing horses for some years; and the object of the Society in offering this premium, is to ascertain the *portable* manures most efficacious in overcoming the inert properties of peat and rendering it productive. The Reporter must state the depth and composition of the Moss experimented on;—the nature of the drainage; the fertilisers employed, the mode of application, and the results obtained.

Reports to be lodged by 1st November 1852.

7. MANURES PRODUCED BY DIFFERENT KINDS OF FEEDING.

For an approved Report of the result of experiments for ascertaining the comparative value of Farm-yard Manure, obtained from cattle fed upon different varieties of food, by the application of such manures to farm-crops—Twenty Sovereigns.

The Report must state the effects produced on two successive Crops, by the application of manures obtained from cattle fed on different sorts of food, such as turnips and straw alone; turnips and straw, with an addition of oil-cake, flax-seed, bean-meal, grain, or other substances. The animals should be as nearly as possible of the same age, weight, condition, and maturity, and each lot should receive daily the same quantity of litter; and, except as to the difference of food, they should be treated in every respect alike.

The preparation of the Manure by fermentation or otherwise, should be in every respect the same; and it is desirable that not less than two several Experiments be made with each kind, and that the ground to which it is to be applied be as equal as possible in quality, and treated in every respect alike.

Competitors to send sealed bottles containing samples of each manure, at the time of its application, for analysis to Dr Anderson, the Society's chemist. The analyses will be performed at the expense of the Society.

Reports to be lodged by 1st May in any year.

8. MANURE MADE WITH AND WITHOUT COVER.

For an approved Report on the comparative value of Manure made in the ordinary manner, and of Manure kept under cover till applied to the land—Twenty Sovereigns.

The experiment may either be conducted with Manure made in the open straw-yard, contrasted with that made in covered hammels, or conducted with Manure made in feeding-houses, part of which shall have been placed under cover, and part removed to the dung-pit. Preference will be given to experiments embracing both of these modes. The Cattle must be fed and littered alike. There must be at least an acre of land experimented on with each sort of Manure—the different lots must be manured to the same extent, and be of equal quality of soil, and on two separate portions of each, not less than 20 poles, the crop must be accurately measured. The results, as given by two successive crops, to be reported.

Competitors to send sealed bottles containing samples of each Manure, at the time of its application, to Dr Anderson, for analysis, which will be performed at the expense of the Society.

Reports to be lodged by 1st May in any year.

9. COMPOST HEAPS.

For an approved Report on the management and application of Compost Heaps—The Gold Medal, or Ten Sovereigns.

The Report must state the substances employed; the crops to which they have been applied; the nature of the land, and its previous management, and the results of the application. The attention of Competitors is directed not only to the use of such substances as may be found on the farm itself, as vegetable refuse, peat and coal ashes, the mud of ponds and ditches, the scrapings of roads, &c., but to such foreign substances as they may have been able to mix with the matter of the heaps, and which have been found to add to their quality and usefulness, such as the offal of shambles and fishing-stations, the refuse-matter of manufactories, and any other substances which can be rendered available as manures.

Reports to be lodged by 1st November 1852.

10. SHELL AND CORAL SAND.

For an approved Report on the application of Shell, or of Coral Sand, as a fertiliser—The Gold Medal, or Ten Sovereigns.

The Report must state the quantity of Shell or Coral Sand available in any district; its composition, and the expense of its collection and application, and the mode thereof. Its effects must, as far as possible, be tested by the weight or measurement of the crops, and the value of the Report will be enhanced by experiments made on similar land with different quantities of the same sand. The Reporter is required to specify the price at which the sand can be purchased, and the facilities for exporting it.

Competitors to send samples of the sand experimented with to Dr Anderson.

Reports to be lodged by 1st November 1852.

11. TOP-DRESSING FOR GRASS.

For an approved Report on the substances which may be most profitably employed in Top-dressing Grass, whether for Hay or Pasture—The Gold Medal, or Ten Sovereigns.

The Report must state the nature of the substances used, the time and cost of the application, and the comparative results, which must also be contrasted with those obtained from a portion of the same field to which no top-dressing was applied.

Reports to be lodged by 1st November 1852.

12. TRIFOLIUM INCARNATUM, OR CRIMSON CLOVER.

For an approved Report on the cultivation of the Crimson Clover, to determine its uses for Green Forage, by having it sown in summer and autumn, as well as spring—The Gold Medal, or Ten Sovereigns.

Reports to be lodged by 1st November 1852.

13. IMPROVED VARIETIES OF AGRICULTURAL PLANTS.

For an approved Report, detailing the means which may have been successfully employed by the Reporter for obtaining new and superior varieties, or improved sub-varieties, of any of the Cereal Grains, Grasses, Roots, or other Agricultural Plants—The Gold Medal, or Ten Sovereigns.

It is necessary that the varieties and sub-varieties reported upon shall have been proved capable of reproduction from seed, and also that the relation they bear to others, or well-known sorts, should be

stated. The Reporter is farther requested to mention the effects that he may have observed produced by different soils, manures, &c., on the plants forming the subjects of report, and how far he may have ascertained such effects to be lasting.

Should any improved variety reported upon be the result of direct experiment by cross impregnation, involving considerable expense and long-continued attention, a higher Premium will be awarded.

Reports to be lodged by 1st November 1852.

14. MANGOLD-WURZEL.

For an approved Report on the cultivation of Mangold-Wurzel in Scotland—The Medium Gold Medal, or Five Sovereigns.

The Reporter must state the nature and previous preparation of the soil,—the varieties grown,—the period of sowing,—the mode of thinning and cleaning,—the best means of preventing seeding,—the time and manner of storing,—the crop obtained,—and its comparative value for feeding purposes.

Reports to be lodged by 1st May 1853.

15. CABBAGE.

For an approved Report on the cultivation and uses of the Cabbage, and its comparative value for feeding purposes. Attention is directed to the Common Field Cabbage, the Kail or Green, of different varieties, the Thousand-headed Cabbage or Jersey Cole, and the Kohl-Rabi or Turnip-rooted Cabbage—The Medium Gold Medal, or Five Sovereigns.

Reports to be lodged by 1st May 1853.

16. POTATO.

For an approved Report on the means successfully employed by the Reporter for growing and securing a sound Potato Crop—The Gold Medal, or Ten Sovereigns.

The experiment must be conducted on not less than 9 acres, manured one-half in autumn, the other in spring, and planted in equal proportions with three known varieties, each of which shall be treated alike. The previous rotation and condition of the land,—the general management of the Potato crop,—the modes of storing,—and the state of the Potatoes after being two months in store, must be reported.

Reports to be lodged by 1st May 1853.

17. VEGETABLE PRODUCTIONS OF INDIA, CHINA, AMERICA, ETC.

For an approved Report on the Hardy and useful Herbaceous Plants, including Grains and Grasses of China, Japan, the Islands of the Eastern Archipelago, the Himalaya country, the Falkland and South Sea Islands, California, the high north-western districts of America, or any other country, where such climate exists as to induce the belief that the Plants may be beneficially introduced into the cultivation of Scotland—The Gold Medal, or Ten Sovereigns.

Reporters are required to give the generic and specific names of the plants treated of, with the authority for the same—together with the native names, in so far as known; and to state the elevation of the locality and nature of the soil in which they are cultivated, or which they naturally inhabit, with their qualities or uses; and it is further requested, that the descriptions be accompanied, in so far as possible, with specimens of the plants and their fruit, seed, or other products.

Reports to be lodged by 1st November in any year.

FEEDING OF STOCK.

In the following experiments, the animals selected should be of the same age, sex, and breed, and, as nearly as possible, of the same weight, condition, and maturity. Their live weight before and after the experiment must be stated, and, if killed, their dead weight, and quantity of tallow.

18. BEST MODES OF HOUSING FATTENING CATTLE.

For an approved Report on the comparative advantages of fattening Cattle in stalls, in loose houses or boxes, and in sheds or hammels—Twenty Sovereigns.

The Report must detail the comparative results of actual experiments. The same quantities and kinds of food shall be used. Information is required as to the comparative expense of attendance, the cost of erecting the buildings, and any other circumstances deserving of attention.

Reports to be lodged by 1st May 1853.

19. SOILING AND PASTURING CATTLE.

For an approved Report, founded on experiment, on the comparative advantages of soiling and of pasturing Cattle—The Gold Medal, or Ten Sovereigns.

Reports to be lodged by 1st May 1853.

20. DIFFERENT DESCRIPTIONS OF FOOD.

For an approved Report of experiments for ascertaining the actual addition of weight to *growing* or *fattening* stock, by the use of different kinds of food—Twenty Sovereigns.

The attention of the Experimenter is directed to Turnips, Carrot, Beet, Mangold-Wurzel, Potatoes, Cabbage, as well as to Beans, Oats, Barley, Indian Corn, Flax-Seed, Oil-Cake, or Rape-Cake, and to the effect of warmth and proper ventilation, and the difference between food cooked and raw. The above roots and other kinds of food are merely named as suggestions. Competitors are neither restricted to them, nor obliged to experiment on all of them.

When experiments are made with Linseed and Oil Cake, it is requested that attention be paid to the comparative advantages, economically and otherwise, of the substances in these two states.

Before commencing the comparative experiments, the animals must be fed on equal quantities of the same kinds of food for some time previously.

The progress of different breeds may be compared; this will form an interesting experiment of itself, for Reports of which encouragement will be given.

Reports to be lodged by 1st May 1853.

21. FEEDING ON TURNIPS RAISED WITH DIFFERENT MANURES.

For an approved Report on the progressive improvement and increase in weight (during a period of at least three months) of three lots of Cattle, of not fewer than three in each lot, fed in the following manner—

Three fed on turnips grown with guano.
Three fed on turnips grown with farm-yard manure.
Three fed on turnips grown with guano and farm-yard manure.

—Twenty Sovereigns.

The Premium is offered with the view of ascertaining the comparative feeding properties of Turnips grown with guano and with farm-yard manure.

The Turnips must be grown with the different manures on land of equal quality and in equal condition, and be supplied to each lot of cattle in equal quantities.

Reports to be lodged by 1st May 1853.

22. STORING TURNIPS.

For an approved Report on the results obtained by feeding Cattle on Turnips lifted and stored in November, and by feeding a similar number on the same quantity of Turnips taken from the field during the winter and spring months when required—The Gold Medal, or Ten Sovereigns.

Reports to be lodged by 1st May 1853.

23. DISEASE IN TURNIPS.

For an approved Report on the Disease in Turnips, termed Anbury, or Finger and Toe, detailing the symptoms and progress of the Disease, the supposed predisposing causes, and the means of prevention which have been found most efficacious—The Gold Medal, or Ten Sovereigns.

Reports to be lodged by 1st November 1852.

24. DISEASES OF SHEEP FED ON TURNIPS.

For an approved Report on the nature, symptoms, causes, preventive and remedial treatment, and *post-mortem* appearances, of the Diseases to which Sheep are subject when fed on Turnips, and on the conditions of soil, and management under which such Diseases are most apt to manifest themselves. The popular as well as the scientific names of Diseases to be made use of—The Gold Medal, or Ten Sovereigns.

Reports to be lodged by 1st May 1853.

25. BRAXY IN SHEEP.

For an approved Report on the nature, symptoms, causes, preventive and remedial treatment, and *post-mortem* appearances,

of Braxy in Sheep. The popular as well as the scientific names of Diseases to be made use of — The Gold Medal, or Ten Sovereigns.

Reports to be lodged by 1st November 1852.

26. DISEASES OF SWINE.

For an approved Report on the nature, symptoms, causes, preventive and remedial treatment, and *post-mortem* appearances, of the Diseases incident to Swine. The popular as well as the scientific names of Diseases to be made use of—The Gold Medal, or Ten Sovereigns.

Reports to be lodged by 1st November 1852.

27. FARM STEADINGS.

1. For an approved Report, Plan, and Specification of a Steading and Offices, adapted for a Farm of mixed Husbandry, containing above 200 acres, under a regular rotation—The Gold Medal, or Ten Sovereigns.

Reports and Plans to be lodged by 1st November 1852.

2. For an approved Report, Plan, and Specification of a Steading and Offices, adapted for a Farm of mixed Husbandry, worked by two pair of Horses—The Gold Medal, or Ten Sovereigns.

Reports and Plans to be lodged by 1st November 1852.

28. RURAL ECONOMY ABROAD.

For approved Accounts, founded on personal observation, of any useful practice in Rural or Domestic Economy, adopted in other countries, which may seem fitted for being introduced with advantage into Great Britain—The Gold Medal.

The purpose chiefly contemplated by the offer of this Premium is to induce gentlemen who may visit other countries, to notice and record such particular practices, as may seem calculated to benefit their own country.

Reports to be lodged by 1st November in any year.

§ 2. WOODS AND PLANTATIONS.

1. EXTENSIVE PLANTING.

To the Proprietor who shall, within a period of five years immediately preceding, have planted the greatest extent of ground,

not being less than 150 acres, and who shall communicate to the Society an approved report of his operations, embracing the expense, description of soil, age, kind, and number, per acre, of trees planted, mode of planting, draining, and fencing, and general progress of the plantation, with such observations as his experience may suggest—The Gold Medal.

Reports to be lodged by 1st November in any year.

2. FORMATION AND MANAGEMENT OF YOUNG PLANTATIONS.

For an approved Report of Plantations formed within a period of not more than ten, nor less than five years preceding the date of the Report—The Gold Medal, or Ten Sovereigns.

The Report should comprehend every interesting particular; among others, the exposure, altitude, and general climate of the locality; the previous character and condition of the soil and subsoil; a detailed statement of the expense, including that of inclosing, draining, and fencing, and a specification of the manner in which these operations were performed—the mode of planting adopted—the prevailing weather while planting and for a month after the operation—the kind of trees planted, and the number of each kind per acre—their relative progress—the proportion of blanks and deaths at the end of three years—the system of management—the state of the plantations at the date of making the Report, and any other observations of interest.

Reports to be lodged by 1st November in any year.

3. GENERAL MANAGEMENT OF PLANTATIONS.

For an approved Report on the management of Plantations, from the commencement of the first thinning till the period of yielding full-grown timber—The Gold Medal, or Ten Sovereigns.

The Reporter's attention should be directed to the following points:—the annual progress of the different sorts of trees—the effects of altitude and exposure—the general advantages of shelter—the mode of thinning and pruning adopted—the uses and value of the thinnings—the plan of registry and of valuing, or a specimen of the method in which the forester's book is kept—the valuation at the time of the Report—together with such general remarks as may be thought useful.

The Report is not expected to embrace the formation and early management, further than the description of soil, kinds of plants, whether mixed, or in masses, together with a note of the expense

from the time of planting to the commencement of the first thinning, in so far as such information is in the possession of the Reporter.

Reports to be lodged by 1st November in any year.

4. USES AND VALUE OF TIMBER.

For an approved Report, founded on practical observation and experience, on the economic uses and comparative value of different descriptions of Timber grown in Scotland—The Gold Medal, or Ten Sovereigns.

The object of the Society in offering this Premium, is to elicit information on, and direct attention to, the comparative value of different descriptions of timber, and the purposes to which they can most advantageously be applied,—whether ship-building—dwellings—furniture—machinery of various kinds—fences—pit-props,—or chemical, manufacturing, and other useful purposes.

The Reporter is required to state the popular and scientific names of the different kinds of Trees, the localities on which they are grown, and, in a general manner, the soil and subsoil, altitude, exposure, and mode of management.

He must specify the proper age and time for cutting different sorts of timber, the mode of seasoning, and the period which may have elapsed between felling and using. He must also give the present market value of the different timbers, and information as to the sorts he considers might be cultivated with advantage in various localities.

The attention of Competitors is directed to the differences which are supposed to exist in the quality of the timber in natural and in planted forests.

Reports to be lodged by 1st November of any year.

5. PLANTING WITHIN THE INFLUENCE OF THE SEA, OR ON BARREN TRACTS.

For an approved Report on successful Planting within the influence of the sea, or on exposed sterile tracts, founded on observation of the habits and appearance of the different sorts of trees considered as best suited for such situations—The Gold Medal, or Ten Sovereigns.

Information is particularly desired regarding the species and varieties of trees calculated for growing in situations unfavourable to most of the more generally cultivated sorts, as in bleak heaths, barren sandy links, exposed maritime situations; and the northern slopes of hills.

The Reporter is required to specify the extent and mode of drainage and fencing—the nature of the soil and subsoil—the elevation and exposure of the locality—and its distance from the sea; and, if in his power, he should notice the underlying rocks, and the geological features of the district.

Reports to be lodged by 1st November in any year.

6. ARBORETUM.

For an approved Report on the most varied, extensive, and judiciously arranged collection of hardy, or supposed hardy, forest and ornamental Trees, either *species* or marked *varieties*, of not less than five years' standing, and in Scotland—The Gold Medal, or Ten Sovereigns.

The Arboretum must be formed so as to afford ample space for the full development of the specimens. The Report must specify the nature of the locality—its altitude and exposure—the description and previous preparation of the soil—the date of planting—the system of draining—fencing—and pruning—and any other circumstances which may be supposed to influence the growth of the plants; the number of failures, with the periods when, and circumstances under which these occurred, must also be reported. Information should be added, when in the Reporter's possession, as to the age and average height of the specimens—and whether they are seedlings, cuttings, layers, or grafted plants—and, if possible, the stock on which they have been grafted.

The Report should be accompanied with a correct list containing the names of the different species and varieties, with an authority for each, and a plan shewing the disposition of each specimen. The trees in the Arboretum must be numbered and named relative to the list and plan.

Reports to be lodged by 1st November in any year.

7. DISEASES OF FOREST TREES.

For an approved Report on the diseases incident to Forest Trees in Scotland—The Gold Medal, or Ten Sovereigns.

The Reporter is required to state the kinds of Trees most generally liable to be attacked; the parts first affected; the age of the Tree and period of the season when first observed; the state of the drainage; the altitude and exposure of the locality, and its geological formation; the nature of the soil and subsoil; when and how the Trees were pruned; the remedies, preventive and remedial,

which may have been tried. Information is required as to the causes of decay—whether attacks of insects, or cryptogamic growth—and how far either of these causes may have been induced by the previous sickly or stunted condition of the Tree. Attention is particularly directed to the Beech, Larch, Silver Fir, and White Pine (*Pinus Strobus*), and to the Coniferæ generally.

Reports to be lodged by 1st November in any year.

8. PLANTING ON PEAT MOSS.

For an approved Report on Plantations formed on deep peat moss, not less than eight years previous to the date of the Report—The Gold Medal, or Ten Sovereigns.

It being understood that large tracts of peat moss have been profitably planted in England and Holland, it is considered desirable to obtain information on the subject. The Premium is strictly applicable to deep peat or flow moss; and it is desirable that the condition of the moss in its original state, as well as at the date of the Report, should, if possible, be stated.

The Reporter must describe the mode and extent of the drainage, and the effect it has had in subsiding the moss; the trenching, levelling, or other preliminary operations that may have been performed on the surface; the mode of planting, kinds, sizes, and number of trees planted per acre, and their relative progress and value, as compared with plantations of a similar age and description, grown on other soils in the vicinity.

Reports to be lodged by 1st November in any year.

9. WILLOWS.

For an approved Report on the more extended cultivation of Willows, for basket and other useful purposes—The Medium Gold Medal, or Five Sovereigns.

The Report must state the nature of the soil and subsoil—the time and mode of planting—the expense per acre—the best varieties—and the most profitable applications.

Reports to be lodged by 1st November 1852.

10. FOREST TREES OF RECENT INTRODUCTION.

For an approved Report on the more extended introduction of hardy useful or ornamental Trees, which have not hitherto been generally cultivated in Scotland—The Gold Medal.

The Report should specify, as distinctly as possible, the kind of trees introduced. The nature of the plantation should likewise be described, as to soil, exposure, shelter, and elevation above the level of the sea. The adaptation of the trees for use or ornament, and their comparative progress, should be mentioned.

Reports to be lodged by 1st November in any year.

11. FENCES.

For an approved Report on Plants other than the Hawthorn (*Cratægus Oxyacantha*), which may be employed for enclosures—The Medium Gold Medal, or Five Sovereigns.

The Report must specify the manner in which the fence has been formed—the date of planting—and age of plants—how protected while young—its general progress and management—together with the nature of the soil and subsoil—the altitude and exposure. The attention of the Reporter may further be directed to evergreen fences for ornamental as well as useful purposes.

Reports to be lodged by 1st November 1852.

12. INTRODUCTION OF SEEDS.

To the person who shall send to the Society seeds capable of germination, either of new or recently-introduced Coniferæ, or of the rarer kinds of forest trees—The Medium Gold, or Silver Medal.

Before the Premium is awarded, the number of seedling Plants of each species raised by the Society shall not have been less than 50. Seeds of Coniferæ may be sent home in the cones, wrapped in brown paper, packed in a box, to be kept in a cool, airy part of the cabin, but on no account in the hold, nor in close tin cases. In the event of seeds being separated from the cones, hasty and severe heating in extracting them, should be carefully avoided. Seeds of Hardwood may be packed in brown paper, or in spagnum (moss), or they may be mixed with soil and placed in strong boxes.

Reports to be lodged before 1st November in any year.

NOTE.—Attention is directed to the *Yucca Gloriosa*, a plant well known for its beautiful and durable fibre. It succeeds well as a garden plant, and might perhaps be cultivated to advantage on a more extended scale.

§ 3. WASTE LANDS.

1. IMPROVEMENT OF WASTE LAND BY TILLAGE.

1. To the Proprietor or Tenant in Scotland who shall transmit to the Society an approved Report of having successfully improved and brought into profitable tillage, within five years preceding the date of his communication, an extent of waste and hitherto uncultivated Land, not less than fifty acres—The Gold Medal, or Ten Sovereigns.

2. To the Tenant in Scotland who shall transmit to the Society an approved Report of having, within three years preceding the date of his Report, successfully improved and brought into profitable tillage, an extent of waste and hitherto uncultivated Land, not less than twenty acres on the same farm—The Medium Gold Medal, or Five Sovereigns.

3. To the Tenant who shall transmit an approved Report of a similar improvement of not less than ten acres—The Silver Medal.

The Report may comprehend such general observations on the Improvement of Waste Lands as the writer's experience may lead him to make; but they are required to refer especially to the land reclaimed (which, if not in one continuous tract, must be in fields of considerable extent), to the nature of the soil, the previous state and probable value of the ground, the obstacles opposed to its improvement, the mode of management adopted, and the produce and value of the subsequent crops; the land must have borne one crop of grain, at least, previous to the year in which the Report is made. The Reports must be accompanied by a *detailed statement of the expenditure and return*, and by a certified measurement of the ground. It shall not be competent to include an improvement for which a premium has been awarded, as part of a more extensive improvement, for which a higher premium is subsequently claimed.

Reports to be lodged by 1st November in any year.

2. IMPROVEMENT OF WASTE LAND WITHOUT TILLAGE.

1. To the Proprietor or Tenant in Scotland who shall transmit to the Society an approved Report of having, within three years

preceding the date of his Report, successfully improved the pasturage of not less than thirty acres, by means of Top-Dressing, Draining, or otherwise without tillage, in situations where tillage may be inexpedient—The Gold Medal, or Ten Sovereigns.

2. To the Proprietor or Tenant who shall transmit an approved Report of a similar improvement of not less than Ten acres—The Silver Medal.

Reports must state the particular mode of management adopted, the elevation and nature of the soil, its previous natural products, and the changes produced.

Reports to be lodged by 1st November in any year.

§ 4. AGRICULTURAL MACHINERY.

1. STEAM-POWER.

To the person who shall succeed in the practical application of steam-power to the Ploughing or Digging of Land—Two Hundred Sovereigns.

This premium was offered last year, and is only open to those who lodged notice before the 1st of January of their intention to compete. The merits of their inventions will be determined by a Committee of the Society, and success will be tested by general applicability, by the character of the work, and by the saving in time, labour, and outlay, as compared with horse-power.

2. INVENTION OR IMPROVEMENT OF IMPLEMENTS OF HUSBANDRY.

For approved Reports of such inventions or improvements by the Reporters of any Agricultural Implements or Machines as shall be deemed by the Society of public utility—Medals or Sums not exceeding Fifty Sovereigns.

While a Premium will be given for any successful improvement, the attention of implement-makers and others is specially called to grubbers, harrows, horse-hoes, straw-cutters, distributors of liquid or special manures, &c.

Reports must be accompanied by drawings and descriptions of the implement or machine, and, if necessary, by a model. Models, if approved of, will be deposited in the Society's Museum, and the

expense of their construction will be repaid to the Inventor. When machines or models are transmitted, it must be stated whether they have been elsewhere exhibited or described.

Models and descriptions may be lodged at any time with the Secretary. Models on a scale of 3 inches to the foot will be preferred.

3. MACHINE FOR PREPARING AND MANUFACTURING CLAYS.

For an approved Report on the Machinery best adapted to produce, by one operation, or an uninterrupted series of operations, pipes or tiles from clay in a rough state—The Gold Medal, or Ten Sovereigns.

The object of the Society is to effect economy of labour, by dispensing, if possible, with the separate application of power, as generally employed at present in milling, screening, and moulding the clay, and to substitute for these a continuous process, from the entrance of the rough clay to the delivery of the moulded tile or pipe.

Reports to be lodged by 1st November 1852.

4. EMPLOYMENT OF PEAT IN BURNING CLAY PIPES OR TILES.

For an approved Report on the means which may have been successfully adopted for employing Peat as a substitute for or in combination with Coal, in Burning Drain Pipes or Tiles—The Gold Medal, or Ten Sovereigns.

In many remote inland districts tile draining has hitherto been frequently retarded by the high price of coal. The Society has reason to believe that this difficulty might, in many instances, be to a great degree obviated by the proper use of peat, and this Premium is offered with the view of obtaining the results of trials which may have been instituted.

Reports to be lodged by 1st November 1852.

5. MACHINERY FOR FLAX.

For an approved Report on Machinery for preparing Flax—The Gold Medal, or Ten Sovereigns.

The Report, with Drawings or Models, may embrace all or any part of the Apparatus or Machinery required in the preparation of

Flax, from the separation of the seed to the state in which it is delivered to the heckler.

Reports to be lodged by 1st November 1852.

6. APPLICATION OF IRON.

For an approved Report on the more general application of iron to the purposes of the Farm, as a material for carts, waggons, tram-rails, flakes, stable and byre fittings, shed-pillars, rick-stands, &c., &c.—The Gold Medal, or Ten Sovereigns.

Reports to be lodged by 1st November 1852.

CLASS II.

LIVE STOCK—DISTRICT COMPETITIONS.

§ 1. CATTLE.

DISTRICTS.

1. *The District of Kintyre to the south of the Lands of Skipness, and adjoining the District of Argyll, as after described.*
2. *The Parishes of Rhynie, Gartly, Huntly, Cairnie, Forgue, and Drumblade, and that part of the Parish of Cabrach, in the County of Aberdeen.*
3. *The Northern part of the Stewartry of Kirkcudbright, comprehending the Parishes of Dalry, Kells, Carsphairn, Balmaclellan, Minigaff, Balmaghie, and Parton.*

*4. *The County of Kinross.*

*5. *The District in the West of Perthshire, comprehending the Parishes of Callander, Kilmadock, Kincardine, Comrie, Balquhidder, Aberfoyle, and Port of Monteith, with that part of the District of Breadalbane comprising Glenlochy, Glendochart, and Glenfalloch.*

6. *The County of Inverness.*

* The County of Kinross, and the District in the West of Perthshire, being in connection with the Perth Show, the local Competitions will be deferred till 1853.

7. *The Counties of Ross and Cromarty.*
8. *The County of Fife.*
9. *The County of Wigtown.*
10. *The County of Linlithgow.*
11. *The District of Nithsdale, comprehending the Parishes of Kirkconnel, Sanquhar, Durrisdeer, Morton, Closeburn, Kirkmahoe, Kirkmichael, Dumfries, Carlaverock, Tinwald, Torthorwald, Holywood, Dunscore, Glencairn, Keir, Penpont, and Tynron, in the County of Dumfries; and Troqueer, Terregles, and Irongray, in the Stewartry of Kirkcudbright.*

Class I.

1. For the best Bull, of any pure breed, above two and under eight years old, belonging to a Proprietor or Factor—The Silver Medal.
2. For the Best Bull, of any pure breed, above two and under eight years old, belonging to a Tenant or Proprietor farming the whole of his own lands—Ten Sovereigns.
3. For the second best—Five Sovereigns.

Class 2.

1. For the best pair of Heifers, of any pure breed, of two years old (if Highland breed, three years), belonging to a Tenant or a Proprietor farming the whole of his own lands—Five Sovereigns.
2. For the second best—Three Sovereigns.

Note.—Districts placed on the list since 1851, shall be entitled to the Society's Premiums for three years, the Directors having found it necessary to withdraw the fourth or additional year. The Competitions will, as formerly, be held in alternate years, it being understood, as a condition of the Society's grant, that the Districts shall, in the two intermediate years, continue the Competitions by offering a sum not less than one-half of that given by the Society.

In 1852,

Competitions for the Society's Premiums will take place—

In No. 1 for the fourth or additional year.
Nos. 2 and 3, for the third year.
Nos. 6 and 7, for the first year.

Nos. 8, 9, 10, and 11, will compete for local Premiums.

Conveners of Committees.

For the First District—Richard Campbell, Esq. of Auchinbreck.
For the Second District—The Duke of Richmond, and Robert Simpson, Esq. of Cobairdy.
For the Third District—William Forbes, Esq. of Callendar, M.P., and William Kennedy Laurie, Esq. of Woodhall.
For the Fourth District—Sir Graham Graham Montgomery of Stanhope, Bart., and Charles Stein, Esq. of Hattonburn.
For the Fifth District—John Burn Murdoch, Esq. of Gartincaber.
For the Sixth District—Arthur Forbes, Esq. of Culloden.
For the Seventh District—Colonel Baillie of Redcastle.
For the Eighth District—The Earl of Leven and Melville, and James B. Fernie, Esq. of Kilmux.
For the Ninth District—Robert Vans Agnew, Esq. of Barnbarroch.
For the Tenth District—The Earl of Rosebery, and George Falconar, Esq.
For the Eleventh District—The Duke of Buccleuch, and William Maxwell, Esq. of Carruchan.

RULES OF COMPETITION.

1. The Members of the Society connected with the respective Districts are appointed Committees of Superintendence for regulating the Competitions; three Members to be a quorum.

2. The Convener of each District will summon a meeting of Committee, not later than the 20th of May, for the purpose of determining the time and place of Competition, the nomination of Judges, and other preliminary arrangements. The time and place will be publicly intimated by Conveners, in such a manner as may appear to them most effectual. The Meetings are open to all Members of the Society.

3. The Competitions must take place between the 1st of June and the 1st of November. The animals exhibited must belong to one of the pure Breed,—Short-horn—Ayrshire—Galloway—Angus or Aberdeen polled—or—Highland. The Committee shall select the breed, and specify it in the returns.

4. Stock of an inferior description, or which does not fall within the prescribed regulations, shall not be placed for Competition. The Premiums shall not be divided. No Money Premium shall be adjudged, unless there are three Lots exhibited, and not more than one-half unless there are six. A Competitor may exhibit two lots in each Class. For the Medal, two Lots authorise an award.

5. An animal which has gained the Society's first Premium at a previous District or General Show is inadmissible, except for the Medal; and one which has gained a second Money Premium can only thereafter compete for the first. The same animal cannot be entered for the Medal and the Money.

6. A Tenant may compete with Proprietors and Factors for the Medal with a Bull which has gained the first Money Premium at a Previous Show. When there is any doubt as to whether a Competitor should be ranked as a Proprietor or a Tenant, the point is left to the decision of the Local Committee.

7. A Bull, the property of two or more Tenants, may compete, although the

Exhibitors may not be joint Tenants. Bulls not belonging to the District may compete, provided they are left within it for service.

8. Bulls for which the Money Premiums are awarded must serve in the District at least one season; and the rate of service may be fixed by the Committee.

9. Blank Reports and Returns will be furnished to the Conveners of the different Districts. These must, in all details, be completed and lodged with the Secretary on or before the 1st of December next.

10. It is to be distinctly understood, that in no instance does any claim lie against the Society for expenses attending a Show of Stock, beyond the amount of the Premiums offered; and that all Premiums not applied for within two years from the term of payment (10th February 1853), shall be forfeited.

11. A Report of the Competition and Premiums awarded at the *intermediate* Local Shows, in the several Districts, signed by a Member of the Society, must be transmitted to the Secretary of the Society, on or before the 1st of December in each year.

§ 2. DRAUGHT HORSES.

DISTRICTS.

1. *The County of Dumbarton.*

Alexander Smollett, Esq. of Bonhill, M.P., *Convener of Committee.*

Forty Sovereigns, of which twenty are contributed by the Local Association, will be awarded, as follows:—

1. For the best Stallion, for agricultural purposes, not under three years and nine months, and not above twelve years old—Twenty-five Sovereigns.

2. For the best Mare, for agricultural purposes—Ten Sovereigns.

3. For the best Filly, foaled after 1st January 1850—Five Sovereigns.

2. *The County of Caithness.*

Sir George Dunbar of Hempriggs, Bart., *Convener of Committee.*

3. *The District of Annandale.*

Viscount Drumlanrig, M.P., *Convener of Committee.*

1. For the best entire Colt, for agricultural purposes, foaled after 1st January 1850—Eight Sovereigns.

2. For the best entire Colt, for agricultural purposes, foaled after 1st January 1851—Five Sovereigns.

RULES OF COMPETITION.

1. The Members of the Society in the District are appointed a Committee of Superintendence, as in No. 1 of the Regulations for the Cattle Competitions; and they will

be convened on or before the 10th of March, in the same manner and for purposes similar to those indicated in the said Regulations.

2. The time and place of Competition to be fixed by the Convener, with the concurrence of the Committee, and to be published by him in due time, and in such manner as shall be thought most effectual for the information of those interested.

3. The Competition in Dumbartonshire will take place betwixt 20th March and 1st May; that in Caithness and Annandale at such time as may be fixed by the Committees. The Regulations for Cattle Shows, in regard to the previous intimation to the Committee and Competitors—the power of the Committee to exclude stock, if the animals produced shall be of inferior character—extra expenses—the period within which Premiums must be applied for, and the manner in which the Report is to be certified and transmitted to the Society, are severally applicable to the Premiums for Horses. Evidence must be produced that the Prize Stallions have had produce. Mares must have foals at their feet, or be in foal, and in the latter case, payment of the premium will be deferred till Certificate of birth.

* The Society being anxious to promote the improvement of Draught Horses by encouraging the rearing of entire Colts, limits Stallion premiums to a period of two years, and follows them up by premiums for other two years within the same District for entire Colts.

§ 3. SHEEP.

1. LEICESTER BREED.

DISTRICTS.

1. *The District of Buchan in Aberdeenshire.*
2. *The Counties of Edinburgh and Haddington.*
3. *The County of Forfar.*

1. For the best Tup of any age, belonging to a Proprietor or Factor—The Silver Medal.

2. For the best Tup of any age—Five Sovereigns.

3. For the best three Shearling Tups—Five Sovereigns.

4. For the best Pen of three Ewes, not less than two Shear—Five Sovereigns.

5. For the best Pen of three Gimmers or Shearling Ewes—Four Sovereigns.

The Money Premiums are restricted to Tenants and Proprietors farming their whole properties.

In 1852,

The Society's Premiums will be competed for—

In No. 1. For the second year.

No. 2. For the first year.

No. 3. will compete for local Premiums.

Conveners of Committees.

For the First District—James Russell, Esq. of Adon.

For the Second District—James Aitchison, Esq. of Alderston.

For the Third District—Sir James Ramsay of Bamff, Bart., and William Macdonald Macdonald, Esq. of St Martins.

2. CHEVIOT BREED.

DISTRICTS.

1. *The Parishes of Selkirk, Ettrick, Yarrow, Innerleithen, Traquair, Stow, Galashiels, Ashkirk, and Roberton.*
2. *The County of Roxburgh.*
3. *The Districts of Annandale and Eskdale in Dumfries-shire, and Liddisdale in Roxburghshire.*

1. For the best Tup of any age, belonging to a Proprietor or Factor—The Silver Medal.

2. For the best Tup of any age—Five Sovereigns.

3. For the best three Shearling Tups—Five Sovereigns.

4. For the best Pen of Five Ewes, not less than Two Shear —Five Sovereigns.

5. For the best Pen of Five Gimmers or Shearling Ewes— Four Sovereigns.

The Money Premiums are restricted to Tenants and Proprietors farming their whole properties.

In 1852,

The Society's Premiums will be competed for—

In No. 1. For the fourth or additional year.

No. 2. For the first year.

No. 3. Will compete for local Premiums.

Conveners of Committees.

FOR THE FIRST DISTRICT—Sir James Russell of Ashiestiel, K.C.B., and Alexander Pringle, Esq. of Whytbank.

FOR THE SECOND DISTRICT—John Ord, Esq. of Muirhouselaw.

FOR THE THIRD DISTRICT—Robert Johnstone Douglas, Esq. of Lockerby.

3. BLACK-FACED BREED.

DISTRICTS.

1. *The District of Argyll, together with the Parishes of North and South Knapdale and Kilberry, and the lands of Stonefield and Skipness.*
2. *The District of Cowal in Argyllshire.*
3. *The adjoining parts of the Counties of Perth, Argyll, and Inverness, under Black-faced Sheep.*

1. For the best two Tups, not exceeding four Shear, belonging to a Proprietor, or Tenant paying more than £150 of yearly rent—Five Sovereigns.

2. For the best two Tups, not exceeding four Shear, belonging to a Tenant paying not more than £150 of rent—Five Sovereigns.

3. For the best Pen of five Gimmers or Shearling Ewes, belonging to a Proprietor, or Tenant paying more than £150 of rent—Four Sovereigns.

4. For the best Pen of five Gimmers or Shearling Ewes, belonging to a Tenant paying not more than £150 of rent—Four Sovereigns.

In 1852,

The Society's Premiums will be competed for—

In No. 1. For the fourth or additional year.
No. 2. For the first year.

No. 3. Will compete for local Premiums.

Conveners of Committees.

FOR THE FIRST DISTRICT—John Campbell, Esq. of Stonefield.

FOR THE SECOND DISTRICT—Robert Maclachlan, Esq. of Maclachlan.
FOR THE THIRD DISTRICT—Sir Robert Menzies of Menzies, Bart.

RULES OF COMPETITION.

1. The Members of the Society in the several Districts are appointed Committees of Superintendence, as in Nos. 1 and 2 of the Regulations for Cattle Competitions and they shall be convened by their respective Conveners on or before the 20th of May, in the same manner, and for the same purposes as specified in the said Regulations.

2. The Competitions shall take place between the 1st of June and the 1st of November, and the time and place must be publicly intimated by each Convener within his District.

3. Tups shall have served the usual number of Ewes, for at least three weeks during the previous season. All Prize Tups must serve within the District during the following season. The Competition is open to Tups not belonging to the District, provided they are left to serve in it. Ewes must have reared Lambs during the season. Ewes and Gimmers must be taken from regular breeding hirsels.

4. Animals must not be clipped earlier, or otherwise, than the Stock to which they belong.

5. The Premiums shall not be divided. No Money Premium shall be adjudged unless there are three Lots exhibited, and only one-half unless there are six. Each Competitor may show two Lots. For the Medal, two Lots authorise an award. The other Regulations for Cattle Competitions—in regard to the placing of Stock—the exclusion of Animals which have gained Premiums at previous shows—the right of a Tenant, under certain circumstances, to compete for the Medal—the regulation as to expenses—the period within which Premiums must be applied for—and the manner in which the Reports must be certified and transmitted—are applicable to the Premiums for Sheep.

6. The Society gives these Premiums in alternate years for three Competitions in each District, if, during the intervening years, Premiums are awarded by the District to an amount not less than one-half of the Society's Premiums, and for the same description of Stock.

7. Blank Reports and Returns of Competitions will be furnished to the Conveners of Districts. These must be accurately filled up in all details, signed by the Convener, and transmitted to the Secretary by the 1st of December.

4. SHEARING SHEEP.

The Silver Medal will be given to the best Sheep-shearer in each of the Districts in which the Premiums for Sheep are in operation.

CONDITIONS.

1. A guarantee must be lodged with the Secretary by the 20th of May, that Money Premiums will be awarded at each Competition, to the amount of not less than £2.

2. The District Conveners for the Sheep Premiums shall fix the time and place of Competition, and make all necessary arrangements.

3. The Medal shall not be awarded unless there are three Competitors; and it shall always accompany the highest Money Premium; if two or more Lots appear to be equally well executed, preference shall be given to that executed within the shortest time.

4. The Conveners shall report the particulars of the Competition and the award of the Judges to the Society, along with the Report of the Sheep Premiums in the District.

§ 4. SWINE.

DISTRICT.

The Parishes of Inveraven, Knockando, Cromdale, Kirkmichael, Aberlour, Abernethy, and Duthill.

CONVENER.—James Skinner, Esq. of Drumin.

1. For the best Boar, belonging to a Proprietor or Factor—The Silver Medal.
2. For the best Boar—Four Sovereigns.
3. For the second best—Two Sovereigns.
4. For the best Breeding Sow—Three Sovereigns.
5. For the second best—One Sovereign.

The Money Premiums are restricted to Tenants, and Proprietors farming their whole properties.

The Regulations for Cattle Competitions, pages 34 and 35, are to be held as applicable to the Premiums for Swine; and the Convener and Committee of the Society's Members in the district are accordingly referred to them.

CLASS III.

DAIRY PRODUCE.

DISTRICT.

The County of Renfrew.

CONVENER.—Archibald Campbell, Esq. of Blythswood.

1. BUTTER.

To the Tenant, or Proprietor farming the whole of his own lands in the District, who shall exhibit the best quality of cured

Butter, the quantity not being less than one cwt.—Three Sovereigns.

For the second best—Two Sovereigns.

For the third best—One Sovereign.

To the Proprietor in the District who shall exhibit the best Butter—The Silver Medal.

2. CHEESE.

To the Tenant, or Proprietor farming the whole of his own lands in the District, who shall exhibit the best quality of Cheese from Sweet Milk, the quantity not being less than two cwt.—Three Sovereigns.

For the second best—Two Sovereigns.

For the third best—One Sovereign.

To the Proprietor in the District who shall exhibit the best Cheese—The Silver Medal.

CONDITIONS.

1. The Members of the Society, resident within the District, are appointed a Committee of Superintendence, for the purposes expressed in the Regulations for Cattle Competitions.

2. The Butter or Cheese must be certified to have been made on the Competitor's farm during the season 1852, and to be an average specimen of his Dairy. The Committee shall fix such General Regulations as they may consider proper—and, in particular, the time and place of Competition. In the event of two or more competing Lots being deemed equal in quality, the Premium will be awarded to the Competitor who shall have cured the larger quantity. The successful Competitors, before receiving the Premiums, are required to transmit to the Secretary a detailed Report of the whole process followed by them in the manufacture of their Butter.

A Report of the award of the Premiums to be lodged with the Secretary of the Society on or before the 1st of December 1852.

CLASS IV.

CROPS AND CULTURE.

SEEDS.

The Society, with a view of aiding Local Associations in the improvement of the different Grains, &c., offers the Silver Medal to the growers of the best Seeds of the varieties which may be considered most adapted for the districts in which they are

raised, and for each of which a Premium of Two Pounds has been awarded in the district.

THE FOLLOWING DISTRICTS HAVE APPLIED FOR MEDALS :—

1. County of RENFREW: Convener, Colonel Macdowall of Garthland.

1. Any variety of White Wheat.
2. Sandy Oats.
3. Any variety of Field Bean.
4. Any variety of Potato.

2. Counties of DUMFRIES and KIRKCUDBRIGHT: Convener, James Macalpine Leny, Esq. of Dalswinton.

1. Any variety of White Wheat.
2. Any variety of Barley.
3. Potato Oats.
4. Sandy Oats.
5. Any other variety of Early Oats.
6. Any other variety of Late Oats.
7. Perennial Rye Grass.
8. Any variety of Potato.

3. District of KINTYRE: Convener, Smollett Montgomery Eddington, Esq. of Glencreggan.

1. Sandy Oats.
2. Bere.
3. Mazagan Beans.
4. Perennial Rye Grass.

4. District of BUCHAN: Convener, James Russell, Esq. of Aden.

1. Early Berlie Oats.
2. Perennial Rye Grass.

5. County of HADDINGTON: Convener, James Aitchison, Esq. of Alderston.

1. Red Wheat.
2. Chevalier Barley.
3. Any other variety of Barley.

4. Potato Oats.
5. Late Angus Oats.
6. Hopetoun Oats.
7. Any other variety of Oats.
8. Field Beans.

6. District of WESTER ROSS: Convener, Sir Evan Mackenzie of Kilcoy, Bart.

1. Any variety of White Wheat.
2. Any variety of Barley.
3. Any variety of Oats.
4. Perennial Rye Grass.

7. District of FORRES: Convener, C. L. Cumming Bruee, Esq. of Roseisle, M.P.

1. Any variety of White Wheat.
2. Any variety of Barley.
3. Any variety of Early Oats.
4. Any variety of Late Oats.
5. Perennial Rye Grass.

8. County of INVERNESS: Convener, Arthur Forbes, Esq. of Culloden.

1. Any variety of White Wheat.
2. Any variety of Barley.
3. Any variety of Oats.
4. Perennial Rye Grass.

CONDITIONS.

1. In each District the Convener, appointed by the Society, will fix the time and place of Competition, appoint the Judges, and make all other necessary arrangements, in concurrence with the other Members of the Society, and the Local Association of the District. Conveners will be furnished with blank schedules for returning the awards.

2. The quantity shewn in Competition by each Grower must not be less than three quarters of each variety of grain, two quarters of Beans, Pease, Vetches, or Grass Seeds, and half a ton of Potatoes. There must at least be two Competitors. The sum of £2 awarded by the District may be divided into two Premiums.

3. The Judges shall be guided in their awards—*1st*, By the Purity of the Seed; *2d*, By its freeness from extraneous Seeds; and, *3d*, Where there is an equality in these respects, by the weight.

4. Each Competitor to whom a medal shall be adjudged, must immediately transmit to the Society's Museum, George IV. Bridge, Edinburgh, free of expense, a sample of the Seed. If it is grain or grass, the quantity must not be less than two quarts.

5. The returns must shew, as accurately as possible, the produce per imperial acre, as also the altitude, exposure, and nature of the soil on which the crops were raised, together with the dates of sowing and reaping, and, in the case of grain or grass seed, the weight per bushel. The varieties, for which Premiums have been given, must be named.

The medals will be continued in each District for five consecutive years. Applications from other Districts must be lodged with the Secretary of the Society by 1st of December next.

2. TURNIP SEED.

(1.) PURPLE TOP SWEDE.

DISTRICT—THE COUNTY OF ROXBURGH.

To the person in the County of Roxburgh, who shall, in the year 1853, have grown a quantity of not less than ten quarters of the most approved quality of seed of Purple Top Swedish Turnip (Skirving's variety), from the best and purest approved stock of mature selected and transplanted bulbs, or from turnips produced from the seed of bulbs which shall have been so selected and transplanted—The Gold Medal, or Ten Sovereigns.

(2.) GREEN TOP YELLOW.

DISTRICT—THE ISLANDS OF ORKNEY.

To the person in the Islands of Orkney, who shall, in the year 1853, have grown a quantity of not less than three quarters of the most approved quality of seed of Green Top Yellow Field Turnip (Pollexfen variety), from the best and purest approved stock of mature selected and transplanted bulbs, or from turnips produced from the seed of bulbs which shall have been so selected and transplanted—The Medium Gold Medal, or Five Sovereigns.

The above Premiums are offered, with the view of directing attention to and encouraging the more careful growth of turnip seed from selected and transplanted stocks.

Competitors must lodge intimation of their intention to compete, with the Secretary, on or before the 1st of December next, so as to admit of an inspection of the growing crops being made by persons appointed by the Society, who will be guided in their opinions,—

1st, By the purity of the stock.
2d, By the symmetry of the form.
3d, By the apparent hardiness of the variety.
4th, By its apparent capability of yielding a bulky or heavy crop.

Different varieties must be properly isolated, and in no case shall two sorts be allowed to stand for seed contiguously.

When the turnips intended for seed are at maturity, twenty plants must be sent, free of charge, to the Society's Museum, in 1852.

A certified statement of the extent of ground under crop, and of the quantity of clean marketable seed harvested, must be lodged with the Secretary on or before the 1st of November 1853, and at same time a sample of not less than two quarts of the seed must be transmitted, free of charge, to the Museum.

3. GREEN CROPS ON SMALL POSSESSIONS.

With the view of improving the cultivation of small possessions, by the introduction of Green Crops, the following Premiums, one-half of which is contributed by the respective Districts, will be awarded:—

For the best Green Crop—Three Sovereigns.
For the second best do. —Two-and-a-half Sovereigns.
For the third best do. —One-and-a-half Sovereign.
For the fourth best do. —One Sovereign.

DISTRICTS.

1. The Parishes of Kenmore and Killin, including the portion of the parish of Weem on Loch Tay.—Convener, The Marquis of Breadalbane.
2. The Island of Skye.—Conveners, Lord Macdonald and Norman Macleod, Esq. of Macleod; in their absence, their Factors are authorised to act.
3. The Quoad Sacra Parish of New Pitsligo.—Convener, Sir John Stuart Forbes of Pitsligo, Bart.

CONDITIONS.

1. The competition to be limited to Tenants occupying not more than 40 acres of land.

2. The quantity of ground under Green Crop to be fixed by the Conveners,—at least one-half of the Green Crop to be Turnips, and that portion which is in Green

Crop in 1852 should be sown out, with sufficient quantities of Clovers and Rye Grass, with the White Crop in 1853.

3. The names of intending Competitors must be intimated to the Conveners appointed by the Society, on or before the 15th day of May 1852; but after that date no additional name shall be received.

4. Should there be only one Competitor, the Committee may allow him such portion of one of the Premiums as they may think merited. The Committee may withhold all or any portion of the Premiums.

5. The Inspectors to be fixed by the respective Conveners with the assistance of such other Members of the Society as may attend, shall decide the Premiums.

6. The awards to be intimated to the Secretary of the Society on or before the 1st of December in each year; and Conveners are particularly requested to state in their reports the proportion of each Lot cropped, as above mentioned, and to offer any suggestions which they may consider of importance.

Similar Premiums will be given in five additional Parishes for 1853, and three succeeding years, on guarantees for the payment of one-half of the Premiums being lodged with the Secretary on or before the 1st December next.

4. PLOUGHING COMPETITIONS.

The Silver Medal will be given to the Winner of the first Premium at Ploughing Competitions, where there are fifteen Ploughs, and Premiums to the amount of Three Sovereigns are awarded. To authorise the issue of the Medal, a Report, in the following terms, must be made to the Secretary, within three months of the date of the Competition, by a Member of the Society who was present.

I of Member of the Highland and Agricultural Society, hereby certify that I attended a Ploughing competition at on the when ploughs competed; of land was assigned to each, and hours were allowed for the execution of the work. The sum of £ was awarded in the following proportions, viz.:

[Here enumerate the names and designations of successful competitors.]

In estimating the work of Competitors, attention should be directed to its sufficiency below, as well as to its neatness above, the surface.

On land of average tenacity, the rate of ploughing should be not less than will turn over an imperial acre in ten hours.

A Ploughman can not carry more than one Medal in the same year.

MEDALS IN AID OF PREMIUMS GIVEN BY LOCAL SOCIETIES.

The Society being anxious to co-operate with Local Associations in their efforts to promote improvement, will give a limited number of Medals annually, in addition to the Money Premiums which may be awarded to Tenants by such Associations—

1. For the best managed Farm.

Applied for by the Nairnshire Farming Society.—Convener, James Campbell Brodie, Esq. of Lethen.

By the District of Ballindalloch.—Convener, Thomas Macpherson Grant, Esq.

By the Inverness Farmers' Society.—Convener, Arthur Forbes, Esq. of Culloden.

By the Carrick Farmers' Society.—Convener, P. W. Kennedy, Esq. of Drumellan.

2. For the best managed Dairy.

Applied for by the Bute Farmers' Society.—Convener, Thos. Gibson, Esq. of Spittal, M.D.

3. For the best managed Green Crop.

Applied for by the Ythanside Farmers' Club.—Convener, Charles Napier Gordon, Esq. of Eslemont.

By the Bute Farmers' Society.—Convener, Thomas Gibson, Esq. of Spittal, M.D.

By the Lower Annandale Agricultural Society.—Convener, Colonel Graham of Mossknow.

By the Inverness Farmers' Society.—Convener, Arthur Forbes, Esq. of Culloden.

By the District of Breadalbane.—Convener, The Marquis of Breadalbane.

By the Dalrymple Farmers' Society.—Convener, James Campbell, Esq. of Craigie.

4. For the best kept Fences. *No application.*

5. For the best kept Dunghill.

Applied for by the District of Breadalbane.—Convener, The Marquis of Breadalbane.

6. For the greatest extent of Land, in proportion to the size of the Farm, subsoiled or trench ploughed. *No application.*

7. To the Labourer most expert and efficient in opening and

filling Drains, and otherwise executing the works necessary in thorough Draining.

Applied for by the Nairnshire Farming Society.—Convener, James Campbell Brodie, Esq. of Lethen.

By the Carrick Farmers' Society.—Convener, P. W. Kennedy, Esq. of Drumellan.

8. To the Labourer most expert in Cutting Hedges.

Applied for by the East of Berwickshire Farmers' Club.—Convener, David Milne, Esq. of Milnegraden.

The Medals to be issued will be limited to ten in each class. Applications for 1853 must be lodged by 1st December next, accompanied with a guarantee, that in addition to the Medal, premiums of not less than £3 will be given by the District applying.

CLASS V.

COTTAGES.

1. FOR THE BEST KEPT COTTAGES AND GARDENS.

The following Premiums are offered for competition in the parishes after mentioned. The Medals and one-half of the Premiums are given by the Society, and the other half is contributed by the respective Parishes.

1. For the best kept Cottage in each Parish—One Pound Five Shillings; and where there are four Competitors—The Cottage Medal.

2. For the second best—One Pound.

3. For the third best—Fifteen Shillings.

4. For the best kept Cottage Garden in each Parish—One Pound Five Shillings; and where there are four Competitors—The Cottage Medal.

5. For the second best—Fifteen Shillings.

PARISHES.

County of Aberdeen.

ELLON.—Convener, Charles Napier Gordon, Esq. of Eslemont.

County of Ayr.

DALRYMPLE.—Convener, John Cogan, Esq. Cassilis House.

County of Berwick.

ABBEY ST BATHANS.—Convener, George Turnbull, Esq. of Abbey St Bathans.
AYTON.—Convener, John G. Cockburn, Esq., Harelaw.
BUNCLE.—Convener, John Wilson, Esq. of Cumledge.
CHIRNSIDE.—Convener, John Wilkie, Esq. of Foulden.
COCKBURNSPATH.—Convener, Sir John Hall of Dunglass, Bart.
COLDINGHAM.—Convener, John Wilson, Esq., Edington Mains.
COLDSTREAM.—Convener, Richard Hodgson, Esq. of Carham.
EDROM.—Convener, David Milne, Esq. of Milnegraden.
EYEMOUTH.—Convener, Captain Logan Hume of Broomhouse.
FOULDEN.—Convener, George Cranstoun Trotter Cranstoun, Esq. of Dewar.
HUTTON.—Convener, Captain Jeffreys of Sunwick.
LADYKIRK.—Convener, Rev. Dr Gilly of Norham.
MORDINGTON AND BERWICK LIBERTIES.—Convener, John Campbell Renton, Esq. of Mordington, M.P.
WHITSOME.—Convener, Sir George Houstoun Boswall of Blackadder, Bart.

County of Dumbarton.

BONHILL.—Convener, Alexander Smollett, Esq. of Bonhill, M.P.

County of Edinburgh.

MID-CALDER.—Convener, The Hon. The Master of Torphichen.

County of Forfar.

CRAIG.—Convener, William M. Macdonald, Esq. of St Martins.

County of Perth.

MOULIN.—Convener, Archibald Butter, Esq. of Faskally.
REDGORTON.—Convener, Robert Graham, Esq. of Redgorton.

County of Roxburgh.

YETHOLM.—Convener, Adam Brack Boyd, Esq. of Cherrytrees.

County of Stirling.

KILLEARN.—Convener, John Buchanan, Esq. of Carbeth.

CONDITIONS.

1. The Cottages may either be single or in villages; in every case, the occupiers of Gentlemen's Lodges and Gardeners' Houses shall be excluded, as well as Gentle-

men's Servants occupying Cottages in the policies, or on land in the natural possession of their masters. The inspection must be completed by the 15th of October. In making the inspection, the Conveners may take the assistance of any competent judge.

2. The annual value of each Cottage, with the ground occupied in the parish by a Competitor, shall not exceed £5 sterling; and there must, at least, be three Competitors in each District. A Cottage or Garden which has gained a Premium in a previous year, cannot compete again for the same or a lower Premium.

3. If the Cottage is occupied by the proprietor, the roof must be in good repair; if the roof is of thatch, it must be in good repair, though in the occupation of a tenant. The interior must be clean and orderly,—the windows must be free of broken glass, clean, and affording the means of ventilation. Dunghills, and all other nuisances, must be removed from the front and gables; and the necessary must be kept clean. In awarding the Cottage Premiums, preference will be given to Competitors, who, in addition to these requisites, have displayed the greatest taste in ornamenting the exterior of their houses, and the ground in front and at the gables. In the event of there not being three Competitors, it will be in the power of the Committee to award one-half of the Premium, if the merits of the Cottage or Garden shall appear to be such as to deserve it.

4. In estimating the claims for the Garden Premium, the Judges should have in view—The sufficiency and neatness of the fences; the cleanness of the ground, and neatness of the walks; the quality of the crops, and general productiveness of the garden; and the choice of crops.

5. Reports, stating the number of Competitors, the names of the successful parties, and the nature of the exertions which have been made by them, must be transmitted by the Conveners to the Secretary of the Society, on or before the 1st day of November next.

Parishes desirous of these Premiums must lodge applications with the Secretary on or before the 1st December next.

MEDALS FOR COTTAGES OR GARDENS.

The Society will issue annually twelve Medals to Local Associations or individuals, who, at their own expense, establish Premiums for Cottages or Gardens.

The Medals will be issued upon a Report by a Member of the Society, in the terms required by the preceding conditions, describing the merits of the Cottages or Gardens. The same individual shall not receive more than Two Medals in five years. The Reports to be lodged with the Secretary on or before the 1st November 1852.

2. IMPROVING EXISTING COTTAGES.

To the Proprietor in Scotland who shall Report the improvement of the greatest number of Cottages in the years 1849, 1850, and 1851.—The Gold Medal.

3. BUILDING NEW COTTAGES.

To the Proprietor in Scotland who shall report the erection of the greatest number of approved Cottages during the years 1848, 1849, 1850, and 1851—The Gold Medal.

CONDITIONS.

Claims for the above Premiums must be lodged with the Secretary on or before the 1st of October next, to allow an inspection to be made of the different Cottages. The inspections will be conducted by Committees of the Society's Members in the different Districts; and Reports must be transmitted by the Conveners to the Secretary on or before the 1st December.

The annual value of the Cottage or Cottages separately, with garden ground, must not exceed £5.

In estimating the claims of Competitors, the following points will be kept in view:—The external appearance of the Cottages, their internal accommodation; the arrangements of the outhouses; the means of drainage and ventilation; and the expense of the building or of the alteration compared with its durability and accommodation. When the Cottages of one Competitor are superior in style and comfort to those of another, though not so numerous, the Inspectors to give them the preference, provided they amount at least to three, and have been erected at a moderate expense.

Parties competing to forward plans, specifications, and estimates, to the Society, of which, and of all information sent therewith, copies may be taken for publication, if the Society shall see fit, and the originals returned to the parties within six months, if desired.

4. ACCOMMODATION FOR FARM-SERVANTS.

To the Proprietor in Scotland who shall have erected on his estate, the most approved Farm-buildings in reference to the proper accommodation of Farm-Servants—The Gold Medal.

Reports, Plans, and Specifications, to be lodged by the 1st of November 1852.

AGRICULTURAL MEETING

AND

GENERAL SHOW OF STOCK, DAIRY PRODUCE, AND IMPLEMENTS, AT PERTH,

ON THE 3D, 4TH, 5TH, AND 6TH OF AUGUST 1852.

The District in connection with the Show comprises the Counties of Perth, Fife, Kinross, and Clackmannan, and the Western Division of Forfarshire.

GENERAL ARRANGEMENTS.

TUESDAY,......3d August.—Arrangement and Inspection of Implements.
WEDNESDAY, 4th August.—Exhibition of Implements and Dairy Produce, and Lecture.
THURSDAY,... 5th August.—Exhibition of Stock, Implements, and Dairy Produce, and Public Banquet.
FRIDAY, ... 6th August.—Exhibition of Prize Stock, Implements, &c., and Auction.

The Competition (except for Dairy Produce) is open to Exhibitors from all parts of the Kingdom.

No Certificate of Entry can be received after FRIDAY the 25TH of JUNE.

CLASS I.—CATTLE.

SWEEPSTAKES FOR BULLS.

A SWEEPSTAKES will be sanctioned for the best BULL of any age, in each of the following Breeds :—SHORT-HORN, POLLED, AYRSHIRE, and HIGHLAND. Subscription One Sovereign, with a sum added by the Society equal to that staked for each breed, provided it does not exceed Fifteen Sovereigns for Short-Horns, and Ten Sovereigns for Polled, Ayrshire, or Highland.

PREMIUMS.

SHORT-HORN BREED.

SECTION 1. For the best Bull of any age—Twenty Sovereigns.
To the Breeder of the Best bull—The Silver Medal.
2. For the best Bull calved after 1st January 1850—Ten Sovereigns.
3. For the best Bull calved after 1st January 1851—Six Sovereigns.
4. For the best Cow of any age—Ten Sovereigns.
For the second best—Five Sovereigns.
5. For the best Heifer, calved after 1st January 1850—Eight Sovereigns.
For the second best—Four Sovereigns.
6. For the best Heifer, calved after the 1st January 1851—Five Sovereigns.

POLLED BREEDS.—ANGUS, ABERDEEN, AND GALLOWAY.

7. For the best Bull of any age—Fifteen Sovereigns.
To the Breeder of the best Bull—The Silver Medal.
8. For the best Bull, calved after 1st January 1850—Eight Sovereigns.
9. For the best Bull, calved after 1st January 1851—Five Sovereigns.
10. For the best Cow of any age—Eight Sovereigns.
For the second best—Four Sovereigns.
11. For the best Heifer, calved after 1st January 1850—Six Sovereigns.
For the second best—Three Sovereigns.
12. For the best Heifer, calved after 1st January 1851—Four Sovereigns.
13. For the best Pair of Oxen, calved after 1st January 1849—The Medium Gold Medal.

AYRSHIRE BREED.

14. For the best Bull of any age—Fifteen Sovereigns.
To the Breeder of the best Bull—The Silver Medal.
15. For the best Bull, calved after 1st January 1850—Eight Sovereigns.
16. For the best Cow of any age, in milk—Eight Sovereigns.
For the second best—Four Sovereigns.
17. For the best Cow of any age, in calf—Six Sovereigns.
For the second best—Three Sovereigns.
18. For the best Heifer, calved after 1st January 1850—Six Sovereigns.
For the second best—Three Sovereigns.
19. For the best Heifer, calved after 1st January 1851—Four Sovereigns.

HIGHLAND BREED.

20. For the best Bull of any age—Fifteen Sovereigns.
To the Breeder of the best Bull—The Silver Medal.
21. For the best Bull calved after 1st January 1850—Eight Sovereigns.
22. For the best Cow of any age—Eight Sovereigns.
For the second best—Four Sovereigns.

23. For the best Heifer, calved after 1st January 1849—Six Sovereigns.
For the second best—Three Sovereigns.
24. For the best Heifer, calved after 1st January 1850—Four Sovereigns.
25. For the best Pair of Oxen, calved after 1st January 1848—The Medium Gold Medal.

EXTRA SECTIONS—HIGHLAND BREED.

Open to Tenants paying a rent not exceeding £100 per annum.

26. For the best Bull of any age—Ten Sovereigns.
27. For the best Bull, calved after 1st January 1850—Five Sovereigns.
28. For the best Cow of any age—Five Sovereigns.
29. For the best Heifer, calved after 1st January 1849—Four Sovereigns.
30. For the best Heifer, calved after 1st January 1850—Two Sovereigns.

FIFE BREED.

31. For the best Bull of any age—Ten Sovereigns.
To the Breeder of the best Bull—The Silver Medal.
32. For the best Cow of any age—Six Sovereigns.
33. For the best Heifer, calved after 1st January 1850—Four Sovereigns.

CLASS II.—HORSES,

FOR AGRICULTURAL PURPOSES.

SECTION 1. For the best Stallion—Twenty-five Sovereigns.
For the second best—Ten Sovereigns.
To the Breeder of the best Stallion—The Silver Medal.
2. For the best entire Colt, foaled after 1st January 1849—Ten Sovereigns.
3. For the best entire Colt, foaled after 1st January 1850—Eight Sovereigns.
4. For the best entire Colt, foaled after 1st January 1851—Six Sovereigns.
5. For the best Mare—Ten Sovereigns.
For the second best—Five Sovereigns.

6. For the best Filly, foaled after 1st January 1849—Eight Sovereigns.
7. For the best Filly, foaled after 1st January 1850—Six Sovereigns.
8. For the best Filly, foaled after 1st January 1851—Four Sovereigns.

EXTRA SECTIONS.

9. For the best Highland Pony Stallion, not over 14 nor under 12 hands—Eight Sovereigns.
10. For the best Highland Pony Mare, of the same height—Five Sovereigns.

CLASS III.—SHEEP.

LEICESTER BREED.

SECTION 1. For the best Tup, not exceeding four years old—Eight Sovereigns.
For the second best—Four Sovereigns.
2. For the best Pair of Dinmont or Shearling Tups—Eight Sovereigns.
For the second best—Four Sovereigns.
3. For the best Pen of Five Ewes, not exceeding five years old—Six Sovereigns.
For the second best—Three Sovereigns.
4. For the best Pen of Five Shearling Ewes or Gimmers—Four Sovereigns.

CHEVIOT BREED.

5. For the best Tup, not exceeding four years old—Eight Sovereigns.
For the second best—Four Sovereigns.
6. For the best Pair of Dinmont or Shearling Tups—Eight Sovereigns.
For the second best—Four Sovereigns.
7. For the best Pen of Five Ewes, not exceeding five years old—Six Sovereigns.
For the second best—Three Sovereigns.
8. For the best Pen of Five Gimmers, lambed after 1st April 1851—Four Sovereigns.

BLACKFACED BREED.

9. For the best Tup, not exceeding four years old—Eight Sovereigns.
For the second best—Four Sovereigns.
10. For the best Pair of Dinmont or Shearling Tups—Eight Sovereigns.
For the second best—Four Sovereigns.
11. For the best Pen of Five Ewes, not exceeding five years old—Six Sovereigns.
For the second best—Three Sovereigns.
12. For the best Pen of Five Gimmers, lambed after 1st April 1851—Four Sovereigns.

SOUTHDOWN BREED.

13. For the best Tup, not exceeding four years old—Eight Sovereigns.
For the second best—Four Sovereigns.
14. For the best Pair of Shearling Tups—Eight Sovereigns.
For the second best—Four Sovereigns.
15. For the best Pen of Five Ewes, not exceeding five years old—Six Sovereigns.
For the second best—Three Sovereigns.
16. For the best Pen of Five Shearling Ewes or Gimmers—Four Sovereigns.

CLASS IV.—SWINE.

Section 1. For the best Boar large Breed—Five Sovereigns.
For the second best—Three Sovereigns.
2. For the best Boar, small Breed—Five Sovereigns.
For the second best—Three Sovereigns.
3. For the best Sow, large Breed—Four Sovereigns.
For the second best—Two Sovereigns.
4. For the best Sow, small Breed—Four Sovereigns.
For the second best—Two Sovereigns.
5. For the best Pen of Three Pigs, not exceeding eight months old—Four Sovereigns.
For the second best—Two Sovereigns.

EXTRA STOCK.

Animals of Breeds or Ages not included among the foregoing Premiums, may be entered as EXTRA STOCK, and will be rewarded if commended by the Judges.

CLASS V.—POULTRY.

(IN PAIRS, MALE AND FEMALE.)

SECTION 1. For the best pair of Turkeys, Norfolk or Black breed—One Sovereign.
2. For the best pair of Turkeys of any other breed—One Sovereign.
3. For the best pair of Capon Turkeys—One Sovereign.
4. For the best pair of Fowls, Mottled or Speckled Dorking breed—One Sovereign.
5. For the best pair of Fowls, Polish breed—One Sovereign.
6. For the best pair of Fowls, Spanish breed—One Sovereign.
7. For the best pair of Fowls, Gold or Silver Spangled Hamburgh breed—One Sovereign.
8. For the best pair of Fowls, Grey Speckled or Old Scotch breed—One Sovereign.
9. For the best pair of Fowls, Malay breed—One Sovereign.
10. For the best pair of Fowls, Cochin-China breed—One Sovereign.
11. For the best pair of Fowls of any other breed—One Sovereign.
12. For the best pair of Capons—One Sovereign.
13. For the best pair of Poulards—One Sovereign.
14. For the best pair of Ducks, Aylesbury breed—One Sovereign.
15. For the best pair of Ducks of any other breed—One Sovereign.
16. For the best pair of Geese—One Sovereign.

CLASS VI.—DAIRY PRODUCE.

SECTION 1. For the best sample (not less than 14 lb.) of Butter, cured in 1852—Three Sovereigns.
For the second best—Two Sovereigns.

2. For the best sample (not less than 14 lb.) of Powdered Butter —Three Sovereigns.
   For the second best—Two Sovereigns.
3. For the best sample of Fresh Butter, three Rolls, of ½ lb. weight each—Three Sovereigns.
   For the second best—Two Sovereigns.
4. For the best couple of Cheeses made from Sweet Milk, in 1852 —Three Sovereigns.
   For the second best—Two Sovereigns.
5. For the best couple of Cheeses made from Skimmed Milk, in 1852—Three Sovereigns.
   For the second best—Two Sovereigns.
6. For the best imitation of any known description of English Cheese—Three Sovereigns.
   For the second best—Two Sovereigns.

CLASS VII.—IMPLEMENTS AND MACHINES.

SECTION 1. For the best Two-horse Plough for general purposes —Two Sovereigns.

2. For the best Trench or Deep-Furrow Plough—Two Sovereigns.
3. For the best Subsoil Plough for two horses—Three Sovereigns.
4. For the best Subsoil Plough for moor and stony land, for three or four horses—Two Sovereigns.
5. For the best Double Mould-Board Plough for forming Drills —Two Sovereigns.
6. For the best Ribbing or Drill-Paring Plough—Two Sovereigns.
7. For the best Two-Horse Grubber or Cultivator working on the flat—Two Sovereigns.
8. For the best Drill-Grubber for Green Crops—Two Sovereigns.
9. For the best Norwegian Harrow—Three Sovereigns.
10. For the best Consolidating Land-Roller—Two Sovereigns.
11. For the best Land-Presser, for preparing Seed-Bed for Grain —Three Sovereigns.
12. For the best Pulverising Land-Roller—Three Sovereigns.
13. For the best Harrows—Two Sovereigns.
14. For the best Common Swing-Trees or Draught-Bars—One Sovereign.

15. For the best Equalizing Swing-Trees or Draught-Bars—One Sovereign.
16. For the best Broadcast Sowing-Machine for Grain and Grass Seeds—Three Sovereigns.
17. For the best Drill Sowing Machine for Grain—Three Sovereigns.
18. For the best Horse-Hoe for Drilled Grain Crops—Four Sovereigns.
19. For the best Sowing-Machine for Turnips—Two Sovereigns.
20. For the best Sowing-Machine for Beans, sowing three rows—Two Sovereigns.
21. For the best Dry Manure Distributing Machine—Two Sovereigns.
22. For the best Liquid Manure Distributing Machine—Three Sovereigns.
23. For the best Liquid Manure Pump—One Sovereign.
24. For the best Straw-Cutter for hand labour—Two Sovereigns.
25. For the best Straw-Cutter for power—Three Sovereigns.
26. For the best Turnip-Cutter for Sheep—Two Sovereigns.
27. For the best Turnip-Cutter for Cattle—One Sovereign.
28. For the best Turnip-Cutter for Sheep, adapted for attachment to a Cart—Three Sovereigns.
29. For the best Linseed-Bruiser for hand labour—Two Sovereigns.
30. For the best Grain-Bruiser for hand labour—Two Sovereigns.
31. For the best Grain and Linseed Bruiser for power—Three Sovereigns.
32. For the best Bean-Bruiser for hand labour—One Sovereign.
33. For the best Root-Washer—One Sovereign.
34. For the best Steaming Apparatus for preparing Food—Three Sovereigns.
35. For the best set of Troughs for Feeding Byres—One Sovereign.
36. For the best One-horse Farm Cart—Three Sovereigns.
37. For the best Light Spring-Cart, for farm or other purposes—Two Sovereigns.
38. For the best Harvest Cart—Two Sovereigns.
39. For the best Stone or Iron Stack Pillars, with Framework—Two Sovereigns.
40. For the best Hay Tedding Machine—Two Sovereigns.
41. For the best Horse Stubble or Hay Rake—One Sovereign.

42. For the best Improvement on any part of the Thrashing Machine—Five Sovereigns.
43. For the best Thrashing Machine, not exceeding two-horse power—Six Sovereigns.
44. For the best Thrashing Machine, with English high-speed open Drum, combined with Shakers, Fanners, &c., on the Scotch principle—Ten Sovereigns.
45. For the best Barley Hummeler, for attachment to a Thrashing Machine—Two Sovereigns.
46. For the best Dressing Fanners for Grain—Three Sovereigns.
47. For the best Weighing Machine for the Barn, indicating measure and weight of Grain at one operation—Three Sovereigns.
48. For the best Weighing Machine indicating from 1 lb. to 2 tons —Three Sovereigns.
49. For the best Churn worked by hand—Two Sovereigns.
50. For the best Churn worked by power—Two Sovereigns.
51. For the best Cheese Press—One Sovereign.
52. For the best Curd Cutter for Dairy purposes—One Sovereign.
53. For the best general set of the Smaller Utensils of the Dairy —Two Sovereigns.
54. For the best Field Gate, constructed entirely of Iron—One Sovereign.
55. For the best Field Gate, not constructed entirely of Iron— One Sovereign.
56. For the best set of Traverse Divisions, Rack, and Manger, for Farm Stables—Two Sovereigns.
57. For the best set of Farm Harness—One Sovereign.
58. For the best Machine for making Drain Tiles and Pipes from Clay—Five Sovereigns.
59. For the best Machine for separating extraneous matter from Clay, and preparing it for the manufacture of Tiles and Pipes—Five Sovereigns.
60. For the best Machine for Milling, Screening, and Moulding Clay into Tiles and Pipes by a continuous operation—Five Sovereigns.
61. For the best set of Tiles and Pipes for Field Drainage—One Sovereign.
62. For the best set of Glazed Socketed Pipes for Sewerage— One Sovereign.

63. For the best set of Tools for Cutting Field Drains—One Sovereign.
64. For the best set of Tools for Cutting Open Drains in Hill Pastures—One Sovereign.
65. For the best general set of Hand Implements for the Farm—Two Sovereigns.
66. For the best Apparatus for preparing Flax—Ten Sovereigns.
67. For the best REAPING MACHINE—Twenty Sovereigns.

NOTE.—The Award for the Reaping Machine will not be made at the Show, as it will necessarily depend on the results of a trial, which cannot take place till harvest; but parties intending to compete must exhibit their Reaping Machines at Perth, when the terms and conditions of the subsequent trial will be communicated.

EXTRA IMPLEMENTS.

Premiums will further be awarded to any Newly-Invented or Improved Implement, not included among the foregoing, but entered on the EXTRA LIST, and specially commended by the Judges.

GENERAL REGULATIONS.

1. Members of the Society may enter, free, three Lots of Stock or Implements, under any section of the Premium List, and may exhibit any additional number of lots on paying an entry on each of 2s. 6d. for Stock, and 1s. 6d. for Implements. Exhibitors, not Members of the Society, shall pay on each lot entered. No charge will be made against Tenants exhibiting in the Extra Sections of Highland Cattle. In Class VI. (DAIRY PRODUCE), only one Lot is admissible.

2. Fat Stock must have been the property, and in the possession of the Exhibitor, from the 1st of May preceding the Show. All other Stock from the date of the Certificate of Entry.

3. The ages of Stock will be calculated from the 1st of January of the year of the birth. When the precise age is known, it should be stated in the Certificate of Entry.

4. Cows and Mares must have had produce in the season of the Show, or be in calf or in foal at the time. In the latter case, the Premium will be withheld till certificate of birth.

6. Evidence may be required that Stallions and Bulls, of four years old and upwards, had produce in the preceding year.

6. Sheep must not be clipped earlier, or otherwise than the Stock to which they belong. Aged Ewes must rear Lambs in 1852. Ewes and Gimmers must be taken from regular breeding hirsels.

7. An Animal having already gained a *first* Premium at a General Show of the Society, cannot again compete in the same class, but may be exhibited as Extra Stock for the Silver Medal. *This rule does not apply to the Sweepstakes.*

8. Butter and Cheese must be the produce of Scotch Dairies in 1852, and be certified as of an average quality of the whole quantity made by the Exhibitor, which must be stated. When Skimmed-milk Cheese has not been made in the usual manner, the Judges are authorised to exclude the sample from competition. The quantity of each variety of Sweet and Skimmed Milk Cheese made during the season must not be less than two cwt.

9. The Premiums awarded will be paid on or after the 10th of February 1853. *Premiums not applied for within two years from the term of payment will be forfeited.*

CERTIFICATES OF ENTRY.

1. Stock, Dairy Produce, and Implements, must be intimated by a Certificate for each lot, according to the forms hereto annexed.

2. Printed forms of Certificates may be had on application to the Secretary, at No. 6 Albyn Place, Edinburgh, or to Messrs Mackenzie and Dickson, Secretaries to the Local Committee, George Street, Perth.

3. Certificates must be completed and lodged with the Secretary, or the Local Secretaries, not later than Friday the 25th of June.

4. Admission Orders to the Show-Yard will be given when the Certificates of Entry are lodged.

5. Subscriptions to the Sweepstakes must be paid along with the Entry.

FORM OF CERTIFICATE FOR STOCK, ETC.

I, of , near in the county of , do certify, that my of the Breed, to be exhibited at Perth in Section , bred by , and purchased by me from , on or about , fed on , will, when exhibited, be years and months old. Witness my hand this day of 1852.

(*Signature of Exhibitor.*)

N.B.—Any Observations with reference to other particulars may be subjoined to the above Certificate. *The Exhibitor must say whether he means to offer his Stock for sale at the Auction.*

FORM OF CERTIFICATE FOR IMPLEMENTS.

Section of Premium List.	Name and use of Implement.	Maker's name and address.	Inventor's name and address.	Price.

(*Signature of Exhibitor.*)

Any necessary observations may be subjoined.

PLACING AND JUDGING OF IMPLEMENTS.

1. The Show-Yard will be open for the reception of IMPLEMENTS at Seven o'clock on the morning of Tuesday the 3d of August, and all Articles must be placed by Two o'clock. No article will be admitted without an admission order.

2. The different articles must be placed in their respective Sections according to the classification in the Premium List.

3. A separate space will be reserved for Exhibitors who are desirous of showing a general collection. A moderate charge will be made according to the extent of ground required, which must be intimated to the Secretary on or before the 25th of June. No Exhibitor shall be entitled to this privilege who is not a Competitor.

4. The necessary materials for trying machines must be provided by Exhibitors, except Clay for Tile Machines, which will be furnished by the Society.

5. All articles must be exhibited full size. The wood or iron work should not be painted, but may be coated with transparent varnish. Exhibitors must be provided with instruments for separating the parts of Implements or Machines.

6. The Judges will commence their inspection on the 3d of August, at Two P.M., and they will resume it the following morning at Seven.

7. Practical utility will be considered more than mere ingenuity of design; substantial workmanship will be preferred to highly-finished execution; and due weight will in all cases be given to economy, both as regards the price of the Implement and the saving of labour effected by it.

8. The Yard will be open to the Public on Wednesday the 4th of August, at One o'clock.

9. All Articles entered, whether in Competition or for General Exhibition, must remain in the Yard till Four o'clock on Thursday the 5th of August.

DAIRY PRODUCE.

1. Dairy Produce must be brought to the Show-Yard on the morning of Wednesday the 4th of August, between the hours of Seven and Nine. No article will be admitted without an admission order.

2. The Judges will commence their inspection at Nine o'clock.

3. All Articles must remain in the Yard till Four o'clock on Thursday the 5th of August.

PLACING AND JUDGING OF STOCK.

1. Stock must be brought to the Show-Yard between Five and Seven o'clock on the morning of Thursday the 5th of August. No stock will be admitted without an admission order. At Seven o'clock the Show-Yard will be cleared of all persons except the Judges.

2. One Servant for each Lot only will be admitted, and he must continue in charge of his Lot in the Show-Yard. Bulls must be secured by a ring or screw in the nose, with a chain or rope attached. The Competing Stock will be distinguished by numbers, and the Owner's name must not be mentioned till the Premiums are decided.

3. The Judges will commence their inspection at Seven o'clock. They will decide without inquiry as to names of parties or places; their awards shall make reference merely to the numbers which distinguish the animals. The Judges will report not

only the animals entitled to Premiums, but also the lot next in merit in each Section, to meet the contingency of any challenge which may be made against the Prize Animals.

4. The Judges will have regard to the symmetry, early maturity, purity, size, and general qualities characteristic of the breeds of which they judge. They will make due allowance for age, feeding, and other circumstances bearing on the character and condition of the animals. They will not award Premiums to overfed Bulls, Cows, or Heifers, the object of the Society being to encourage superior animals for breeding. In no case shall a premium be awarded unless the Judges deem the animals to have sufficient merit, more especially if only one lot is presented for any of the Premiums; and it shall be in their power to suggest the removal of any lot which appears to them unworthy of being placed in the Yard.

5. A Member of Committee will attend each Section of the Judges. It will be his duty to see that no obstruction is offered to them; to communicate between them and the Secretary; to complete their Reports; and to affix Tickets on the animals to which Premiums shall be awarded. None of the Tickets so placed shall be removed.

6. On Thursday the Stock shall be withdrawn, and the Show-Yard closed at Four o'clock.

EXHIBITION OF PRIZE STOCK.

All the Prize Animals, Implements, and other articles shall be on the Show-Ground by Ten o'clock on the morning of Friday the 6th of August, under penalty of forfeiting the Premiums. Owners of animals commended by the Judges are invited to show them on this day, when a favourable opportunity will be afforded for selling.

AUCTION.

An Auction of Stock and Implements exhibited, will be held within the Show-Yard, on Friday the 6th of August, by Mr James Fairbairn of Kelso, under the sanction of the Society. The Regulations will be published along with the usual Programme of Business.

VETERINARY COLLEGE.

This Establishment is conducted under the superintendence of Professor Dick, Veterinary Surgeon, the Society's Lecturer. The curriculum of study embraces the principles and practice of Medicine and Surgery applied to domesticated animals; Anatomy and Demonstrations; Pharmacy; Chemistry; and Materia Medica.

Students have the advantage of assisting in an extensive practice, and of performing the different operations which most frequently occur.

Attendance at Two Courses is required before a Student is taken upon trial for diploma; and the Graduates of the College are eligible for appointments as Veterinary Surgeons in Her Majesty's Service, and that of the East India Company.

MUSEUM.

The Museum, George IV. Bridge, is open from eleven till three o'clock every day except Monday. The public are admitted on inscribing their names in the Visitors' Book. Persons desirous of preserving Models of Agricultural Implements or Machines, or Vegetable or Mineral Specimens, are invited to transmit them to the Conservator of the Museum, by whom they will be included in the Collections, if approved of by the Directors.

MONTHLY MEETINGS.

Periodical Meetings are held in the Museum, when Papers are read, and subjects in the science and practice of Agriculture are discussed. Strangers are admitted to the Meetings on application to the Secretary, but only Members can take part in the business.

LABORATORY.

Dr Anderson, the Society's Chemist, will receive Communications, on all subjects connected with the Chemical Department, at the Laboratory, 17 Nicolson Street, entry by Gate at north side of College of Surgeons.

The following are the rates at which analyses, &c. are furnished to *Members of the Society*:—

1. Complete analysis of a Soil, including determination of alkalies and phosphates, £3.
2. A partial analysis of a Soil, such as the determination of the quantity of organic matter, and relative proportion of clay, sand, and carbonate of lime it contains, 10s.
3. Quantitative determination of any one ingredient of a Soil, 7s. 6d.

4. Complete analysis of Saline Manures and other substances, such as Gypsum, Nitrates of Soda and Potash, Ammoniacal Salts, Guano, Oil-Cake, Bone-Dust, Rape-Dust, Superphosphate of Lime, £1.
5. Testing any of the above substances for adulterations,—for each sample, 5s.

   This examination is sufficient to determine whether or not any of these substances are grossly adulterated, but it gives no idea of the comparative values of different Samples where all are genuine.

6. Complete analysis of limestones, marls, shell-sands, &c., £1.
7. Examining any of the above substances for the quantity of lime, and ascertaining in the same the presence of Magnesia and Alumina, 7s. 6d.

   Ascertaining the proportion of these, 2s. 6d. additional for each substance.

8. Complete analysis of the Ashes of any Plant, £3.
9. Complete analysis of a water, £2.
10. Determination of the amount of Salts in solution, and of the lime thrown down by boiling, in any water, 10s.
11. Analysis of Tile or Fire Clay, £1, 10s.
12. Examining products of vegetation, or of the Dairy, such as nutritive matters in wheat, or other grain,—quantity of butter or cheese in milk, 5s. for each ingredient.
13. Answers to Letters asking advice on subjects within the department of the Chemist, 5s.

The charges for other analyses not specified in this list, will be settled by the Committee of Management, with reference to the amount of work which they involve, and on a scale similar to the above.

Members applying for analyses, are requested to specify the nature of the information required, and, if possible, the object in view, as by doing so much trouble and delay may occasionally be saved.

By order of the Directors,

JN. HALL MAXWELL, *Secretary*.

EDINBURGH, 6 ALBYN PLACE,
10th February 1852.

PREMIUMS

OFFERED BY

THE HIGHLAND AND AGRICULTURAL SOCIETY OF SCOTLAND,

1853.

CONTENTS.

PRELIMINARY NOTICE.

WHEN the HIGHLAND SOCIETY was instituted in the year 1784, and sanctioned by a Royal Charter in 1787, its objects, comparatively, were few, and their operation was limited to matters connected with the amelioration of the Highlands of Scotland.

The patronage of certain departments, proper to that part of the country, having been subsequently committed to special Boards of Management, or undertaken by other Associations, several of the earlier objects contemplated by the Society were consequently abandoned, while the progress of science led to the adoption of others of a more general character.

The exertions of the Society, instead of being restricted to the improvement of the Highlands, were early extended to that of the Lowlands, and have in both, for nearly seventy years, been directed to the promotion of the science and practice of Agriculture, in all its various branches.

In accordance with this more enlarged sphere of operation, the original name of the Society was altered, under a Royal Charter in 1834, to THE HIGHLAND AND AGRICULTURAL SOCIETY OF SCOTLAND.

The leading purposes contemplated by this Institution, will be sufficiently explicit on perusal of the following pages, and reference to preceding practice.

Premiums are awarded for Reports on almost every subject connected with the improvement and cultivation of the soil; the rearing

and feeding of stock; the proper management of the dairy; the growth of timber; the extension of improved Cottage accommodation; and the invention of Agricultural Machinery and Implements.

Among the more important measures which have been effected by the Society, are,—

1. The establishment of Cattle Shows and Agricultural Meetings held in different parts of Scotland, at which exhibitors, from all parts of the United Kingdom, have an opportunity of competing for premiums offered for Live Stock, Implements, &c.

2. The establishment of a system of District Shows, instituted for the purposes of improving the Breeds of Stock most suitable for different parts of the country, and of aiding and directing the efforts of Local Agricultural Associations.

3. The advancement of the Veterinary Art by the establishment of a College in Edinburgh, where courses of Lectures are delivered, and Students are instructed in the most approved modes of treatment.

4. The appointment of a Chemist and the establishment of a Chemical Department, for the purpose of promoting the application of science to Agriculture. Investigations on subjects of importance are conducted in the Laboratory, and published in the Transactions. Members have the privilege of applying for analyses of Soils, Manures, &c., on favourable terms.

5. The erection of a Museum for models of Agricultural Implements and Machines, Vegetable and Mineral Specimens, and Paintings of Prize Animals.

6. The periodical publication of the Transactions, which comprehend the proceedings in the Laboratory, Reports of Experiments, and other communications addressed to the Society. The Transactions are published by Messrs BLACKWOOD and SONS, Edinburgh, along with the Quarterly Journal of Agriculture.

7. The establishment of Monthly Meetings in the Museum for the discussion of Agricultural subjects.

CONSTITUTION AND ESTABLISHMENT.

The whole affairs of THE HIGHLAND AND AGRICULTURAL SOCIETY are conducted under the sanction and control of a Royal Charter, which authorises the enactment of Bye-Laws.

The Office-Bearers consist of a President, four Vice-Presidents, ten Extraordinary, and thirty Ordinary Directors, a Treasurer, and an Honorary and Acting Secretary.

The proceedings of the Directors are reported to Half-yearly General Meetings of the Society, one of which is, by the Charter, appointed to be held on the second Tuesday of January, and the other on such day in the months of June or July as the Directors may fix.

New Members are admitted at either of these General Meetings by Ballot. The ordinary subscription is £1, 3s. 6d. annually, which may be redeemed by one payment varying from £12, 12s. to £7, 1s. Tenant Farmers, Members of any local Society, are admitted on a subscription of ten shillings annually, or £5, 5s. for life.

The Premiums awarded by the Society are payable after the 10th February, for the preceding year. Orders, payable at the Royal Bank of Scotland, are issued at the Society's Hall, on the stamped receipt of parties to whom the Premiums have been adjudged being presented; or such receipts may be transmitted through a Bank, addressed to the Secretary, if done without expense to the Society. The receipt must specify distinctly the Premium in discharge of which it is sent.

Premiums not applied for within two years from the term of payment, will be forfeited.

All communications are to be addressed to the Secretary of the Society, 6 Albyn Place, Edinburgh.

ESTABLISHMENT FOR 1853.

President.

HIS GRACE THE DUKE OF HAMILTON AND BRANDON.

Vice-Presidents.

THE VISCOUNT STRATHALLAN.
LORD POLWARTH.
THE EARL OF HOME.
THE EARL OF MINTO.

Extraordinary Directors.

SIR RALPH A. ANSTRUTHER of Balcaskie, Bart.
ROBERT BRUCE of Kennet.
HENRY HOME DRUMMOND of Blairdrummond.
JOHN FERGUS of Strathmore, M.P.
JAMES JOHNSTONE of Alva, M.P.
SIR HUGH HUME CAMPBELL of Marchmont, Bart.
SIR WILLIAM SCOTT of Ancrum, Bart.
SIR JOHN HALL of Dunglass, Bart.
DAVID ROBERTSON of Ladykirk.
WILLIAM OLIVER RUTHERFURD of Edgerston.

Ordinary Directors.

CHARLES CRAIGIE HALKET INGLIS of Cramond.
WILLIAM DUDGEON, Leith.
Sir JAMES WALKER DRUMMOND of Hawthornden, Bart.
ROBERT STEUART of Carfin.
JAMES CAMPBELL, Edinburgh.
WILLIAM MACKENZIE of Muirton.
JOHN BRODIE, Abbey Mains.
JOHN GIBSON, Woolmet.
ARCHIBALD TROTTER of Dryden.
JAMES ANSTRUTHER, Edinburgh.
ROBERT BALFOUR WARDLAW RAMSAY of Whitehill.
ANTHONY MURRAY of Dollerie, W.S.
STEUART BAYLEY HARE of Calderhall.
JOHN HUTTON BALFOUR, M.D., Professor of Botany, University of Edinburgh.
DAVID ANDERSON of St Germains.
JOHN DUDGEON, Almondhill.
THOMAS OGILVY of Corrimony.
ALEXANDER MORISON of Bognie.
ALEXANDER PRINGLE of Whytbank.
ARCHIBALD BUTTER of Faskally.
PATRICK SMALL KEIR of Kinmonth.
ARCHIBALD CAMPBELL SWINTON, younger of Kimmerghame.

David Milne Home of Wedderburn.
James Maitland Balfour of Whittingham.
Sir John Muir Mackenzie of Delvin, Bart.
John Beatson Bell of Glenfarg.
George Falconar, Foxhall.
Sir William Gibson-Craig of Riccarton, Bart.
John Learmonth of Dean.
James Tytler of Woodhouselee.

Office-Bearers.

Alexander Maconochie of Meadowbank, *Treasurer.*
Sir John Stuart Forbes of Pitsligo, Bart., *Honorary Secretary.*
John Hall Maxwell of Dargavel, *Secretary.*
Rev. James Grant, D.D., *Chaplain.*
Thomas Anderson, M.D., Prof. of Chemistry in the University of Glasgow, *Chemist.*
Archibald Horne, *Auditor.*
William Blackwood and Sons, *Publishers.*
Neill and Company, *Printers.*
Charles Lawson, *Seedsman and Nurseryman.*
William Dick, *Professor of Veterinary Surgery.*
James Mackay, *Silversmith.*
Alexander Kirkwood, *Medallist.*

Chairmen of Standing Committees.

Argyll Naval Fund,	Alexander Lamont of Knockdow.
Chemistry,	William Gregory, M.D., Professor of Chemistry in the University of Edinburgh.
Cottages,	Robert G. Baillie of Culterallers.
District Shows,	Robert Maclachlan of Maclachlan.
Finance,	George Turnbull of Abbey St Bathans.
General Shows,	Donald Horne of Langwell.
Geology,	David Milne Home of Wedderburn.
Machinery,	John Miller of Leithen, C.E.
Premiums,	David Low of Laws, Professor of Agriculture in the University of Edinburgh.
Publications,	George Makgill of Kemback.
Veterinary College,	John Goodsir, Professor of Anatomy in the University of Edinburgh.

Museum.

Lord Berriedale, *Chairman.*
Robert Graham of Redgorton, *Deputy-Chairman.*
Charles Lawson, *Conservator.* James Slight, *Curator of Models.*
Edward J. Ravenscroft, *Assistant-Conservator.*

Monthly Meetings.

The Duke of Buccleuch, *Chairman.*
Sir John M'Neill, G.C.B.; Professor Low; W. B. Callander of Prestonhall; and David Milne Home of Wedderburn, *Deputy-Chairmen.*

PREMIUMS.

GENERAL REGULATIONS FOR COMPETITORS.

All Reports must be written in a distinct and legible hand, and on one side only of the paper; the number and subject of the Premium for which they are in Competition must be stated; they must bear a distinguishing motto, and be accompanied by a sealed letter similiarly distinguished, containing the name and address of the Reporter.

None of the sealed letters, except those relative to Reports found entitled to at least one-half of the Premium offered, shall be opened without the Author's consent.

Reports for which a Premium, or one-half of it, has been awarded, become the property of the Society, and cannot be published, in whole or in part, nor circulated in any manner, without the consent of the Directors. All other papers will be returned to their Authors if applied for within twelve months.

Models accompanying communications on Agricultural Machinery, for which Premiums have been awarded, become the property of the Society, a reasonable sum being allowed to the Inventor for the expense of construction.

When a Report is unsatisfactory, the Society is not bound to give the reward offered; and power is reserved of awarding such part only of a Premium as the claim may be adjudged to deserve.

All Reports must be of a practical character, containing the results of the writer's own observations or experiment. Papers compiled from books will not be rewarded.

Weights and Measurements must be indicated by the New or Imperial Standards. The decisions of the Board of Directors, confirmed by the Society, are final and conclusive as to all Premiums, whether offered for Reports, or at General or District Shows, and it shall not be competent to raise any question or appeal touching such decisions before any other tribunal.

Reports, or Communications, on subjects for which Premiums have in former years been offered, will still be received, although the subjects may now be discontinued on the list, and honorary awards will be given, when the communications appear to merit them.

CLASS I.

REPORTS.

§ 1. ON SUBJECTS CONNECTED WITH THE SCIENCE AND PRACTICE OF AGRICULTURE.

1. DRAINING.

For an approved Report on the comparative results of Draining at different depths and distances—The Gold Medal, or Ten Sovereigns.

The comparative Experiment should be conducted, if possible, on the same field; at all events on contiguous fields, characterised alike in point of fall, outfall, soil, and subsoil.

The Report must state full particulars as to the dimensions of the Drains—the distance between each—the materials used—the expense of construction—the nature of the soil and subsoil—and the results obtained.

Reports to be lodged by 1st November 1853.

2. DEEP PLOUGHING.

For an approved Report on the comparative results obtained by the following modes of Ploughing:—1*st*, By the Common Plough, with a furrow not less than eight inches; 2*d*, By the Common,

or the Trench Plough, with a furrow not less than ten inches; 3*d*, By the Subsoil Plough—The Gold Medal, or Ten Sovereigns.

The land operated on must have been thoroughly drained. The Report must state the nature of the soil and subsoil, and the date, depth, and expense of each ploughing. The extent of land to be not less than one acre for each operation, and on each lot the produce of two separate portions, of not less than 20 poles, to be weighed or measured. In every other respect the whole land to be treated alike.

Reports to be lodged by 1st November 1853.

3. PLOUGHING LEA.

For an approved Report of the comparative results obtained by Ploughing Lea in the three following ways:—1*st*, Trench Ploughing; 2*d*, Ploughing at the ordinary depth, but with a high crest or shoulder; 3*d*, Ploughing at the ordinary depth with a rectangular shoulder—The Gold Medal, or Ten Sovereigns.

The Experiment must, in each case, be conducted on not less than half an acre of land, similar in character and condition. Its value will be enhanced if repeated on light and on heavy soil. The land must be ploughed at least one month before seed-time, and the furrow slices measured by a member of the Society. The same seed must be used. The nature of the soil and subsoil—previous rotation—dates of ploughing, sowing, and reaping—and exact produce of each lot in straw and grain must be stated.

Reports to be lodged by 1st November 1854.

4. USE OF THE GRUBBER.

For an approved Report on the advantages of the Grubber as a substitute for the Plough—The Gold Medal, or Ten Sovereigns.

The Report must describe the Grubber used, and state the character of the soil and subsoil, the nature of the drainage, the previous tillage of the land, the crops for which it has been prepared by the Grubber, and the results.

Reports to be lodged by 1st November 1853.

5. SPECIAL MANURES.

Fifty Sovereigns will be awarded in such proportions as the Directors may see proper:—

1. For an approved Report of experiments made with different

manures, both separately and mixed in certain proportions, and applied either in solid or fluid form. It is necessary that the land on which the experiments are to be made shall be of as equal quality and exposure as possible, and that, in the preceding rotation, the whole shall have been treated in every manner alike. Each experiment must be made on two ridges, and the results compared with those obtained from two ridges adjoining, which shall have been manured in the ordinary manner of the farm. Each ridge must contain at least a quarter of an acre. These experiments to be made in duplicate thus:—

<table>
<tr><td>1</td><td>2</td><td rowspan="2">Manured in the ordinary manner of the Farm.</td><td>3</td><td>4</td><td rowspan="2">Manured in the ordinary manner of the Farm.</td><td>5.</td><td>6</td><td rowspan="2">Manured in the ordinary manner of the Farm.</td><td>7.</td><td>8</td></tr>
<tr><td>5</td><td>6</td><td>7</td><td>8</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
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The substances employed may be Guano, Nitrate of Soda, Nitrate of Potash, Sulphate of Soda, Sulphate of Magnesia, Sal-Ammoniac, Sulphate of Ammonia, Soda Ash, Pearl Ash, Kelp, Bones, Soot, Coal-Ashes, or mixtures of these in specified proportions, and any others of known composition, which the experimenters may select. Poudrette or Prepared Night-Soil, and the Ammoniacal liquor of Gas-Works, should also be tried; and it is particularly recommended that the refuse of Manufactories, such as the Prussiate of Potash,—the refuse of Sugar-Works, Salt-Works, Bleach-Works, and Glue-Manufactories, should be collected and experimented upon.

It is recommended that the experiments should be made with quantities of the different substances corresponding to their chemical equivalents, and that when the refuse of manufactories is employed their composition should, as far as possible, be determined by analysis.

The following is a list of the equivalents of the different salts above mentioned :—

Nitrate of Potash, . .	101·3
Nitrate of Soda, . .	85·4
Sulphate of Potash, . .	87·2
Sulphate of Soda, dry, . .	71·6
Sulphate of Ammonia, . .	80·3
Sal-Ammoniac, . .	53·5
Carbonate of Potash (Pearl Ash), .	69·2
Carbonate of Soda (Soda Ash), .	53·4
Sulphate of Magnesia, crystallized,	123·8
Sulphate of Lime (Gypsum), .	86·6

In explanation of this list, experimenters should understand, that if they have resolved to make an experiment, say with 101 lb. of nitrate of potash, they ought to contrast it not with 101 lb. of nitrate of soda, but with 85·4 lb., and if any other quantities are fixed upon, their relation can be readily calculated by the rule of three.

When experiments are made with mixtures, the proportions of the several substances must, in all cases be stated.

The quantity by weight, and the cost of the manures employed, as well as the quantity, quality, and marketable value of the crop produced by each, must be accurately ascertained and reported, with the nature and qualities of the soil, its altitude, exposure, drainage, and such other particulars and observations as the Reporter may deem deserving of attention.

The value of the experiments will be enhanced, if accompanied with an analysis or minute description of the soil on which they are made, and means of proving the purity of the manures which were used.

The experimenter is further required to transmit, along with his report, samples of not less than 2 lb. weight, of all the manures employed.

Reports to be lodged by 1st November 1853.

2. For an approved Report, having reference to the experience of two or more preceding seasons, on the effects which any substances, such as those above named, have produced on the soil for a certain period after their application. In all cases, the subsequent produce of the land which had received the particular manure, must be noted carefully by weight or measure, and compared

with that of an equal portion of land immediately adjoining, which had received no special manure.

Reports to be lodged by 1st November 1853.

6. LIQUID MANURE.

For an approved Report on saving and applying the Liquid Manure of a Farm; on the circumstances under which it can be beneficially applied; and on the profit or loss of the application—The Gold Medal, or Ten Sovereigns.

The Reporter is required to detail the means employed by him for the above purpose. When tanks are used, the best form and position for them must be stated, as well as the most efficient and economical mode of conveying to them the Liquid from the feeding houses or yards, and the period for which the urine should be kept. The Reporter must also state the best mode of applying it to the land, whether directly, or by mixing it with the manure of the yards, or with other fertilising matters. He must also enable the Society to judge of the profit of the process described by him, by giving a detailed statement of the original outlay for works, as well as the annual expenditure in maintaining them, and distributing the Liquid, compared with the returns actually obtained, which must be minutely furnished.

Reports to be lodged by 1st November 1853.

7. SEWAGE MANURE.

For an approved Report on the best means of deodorising, drying, and rendering portable the Sewage of Towns—Twenty Sovereigns.

The Report must be founded on actual experiment; it must describe the substances used, and the method employed in deodorising and drying the Sewage. The expense of the process, and the selling price of the manure must be accurately stated. It must be accompanied by samples of the Sewage in its original state, and of the prepared manure, with an analysis of each, which, on application being made to the Secretary, will be furnished by Dr Anderson at the expense of the Society.

Reports to be lodged by 1st November 1853.

8. MANURES FOR PEAT MOSS.

For an approved Report on the substances best adapted for fertilising Peat Moss—The Gold Medal, or Ten Sovereigns.

There exist in many parts of the country Mosses which, from their depth and situation, cannot be clayed, nor made capable of bearing horses for some years ; and the object of the Society, in offering this premium, is to ascertain the *portable* manures most efficacious in overcoming the inert properties of peat and rendering it productive. The Reporter must state the depth and composition of the Moss experimented on ; the nature of the drainage ; the fertilisers employed ; the mode of application, and the results obtained.

Reports to be lodged by 1st November 1853.

9. MANURES PRODUCED BY DIFFERENT KINDS OF FEEDING.

For an approved Report of the result of experiments for ascertaining the comparative value of Farm-yard Manure, obtained from cattle fed upon different varieties of food, by the application of such manures to farm-crops—Twenty Sovereigns.

The Report must state the effects produced on two successive Crops, by the application of manures obtained from cattle fed on different sorts of food, such as turnips and straw alone; turnips and straw, with an addition of oil-cake, flax-seed, bean-meal, grain, or other substances. The animals should be as nearly as possible of the same age, weight, condition, and maturity, and each lot should receive daily the same quantity of litter; and, except as to the difference of food, they should be treated in every respect alike.

The preparation of the Manure by fermentation or otherwise, should be in every respect the same ; and it is desirable that not less than two several Experiments be made with each kind, and that the ground to which it is to be applied be as equal as possible in quality, and treated in every respect alike.

Competitors to send sealed bottles containing samples of each manure, at the time of its application, for analysis to Dr Anderson, the Society's chemist. The analyses will be performed at the expense of the Society.

Reports to be lodged by 1st May in any year.

10. MANURE MADE WITH AND WITHOUT COVER.

For an approved Report on the comparative value of Manure made in the ordinary manner, and of Manure kept under cover till applied to the land—Twenty Sovereigns.

The experiment may either be conducted with Manure made in the open straw-yard, contrasted with that made in covered hammels

or boxes, or conducted with Manure made in feeding-houses, part of which shall have been placed under cover, and part removed to the open dungpit. Preference will be given to experiments embracing both of these modes. The Cattle must be fed and littered alike. There must be at least an acre of land experimented on with each sort of Manure—the different lots must be manured to the same extent, and be of equal quality of soil, and on two separate portions of each, not less than 20 poles, the crop must be accurately measured. The result, as given by two successive crops, to be reported.

Competitors to send sealed bottles containing samples of each Manure, at the time of its application, to Dr Anderson, for analysis, which will be performed at the expense of the Society.

Reports to be lodged by 1st May in any year.

11. COMPOST HEAPS.

For an approved Report on the management and application of Compost Heaps—The Gold Medal, or Ten Sovereigns.

The Report must state the substances employed; the crops to which they have been applied; the nature of the land, and its previous management, and the results of the application. The attention of Competitors is directed not only to the use of such substances as may be found on the farm itself, as vegetable refuse, peat and coal ashes, the mud of ponds and ditches, the scraping of roads, &c., but to such foreign substances as they may have been able to mix with the matter of the heaps, and which have been found to add to their quality and usefulness, such as the offal of shambles and fishing-stations, the refuse-matter of manufactories, and any other substances which can be rendered available as manures.

Reports to be lodged by 1st November 1853.

12. SHELL AND CORAL SAND.

For an approved Report on the application of Shell, or of Coral Sand, as a fertiliser—The Gold-Medal, or Ten Sovereigns.

The Report must state the quantity of Shell or Coral Sand available in any district; its composition, and the expense of its collection and application, and the mode thereof. Its effects must, as far as possible, be tested by the weight or measurement of the crops, and the value of the Report will be enhanced by experiments made on similar land with different quantities of the same sand. The

Reporter is required to specify the price at which the sand can be purchased, and the facilities for exporting it.

Competitors to send samples of the sand experimented with to Dr Anderson.

Reports to be lodged by 1st November 1853.

13. TOP-DRESSING FOR PASTURE.

For an approved Report on the substances which may be most profitably employed in Top-dressing Pasture—The Gold Medal, or Ten Sovereigns.

The Report must state the nature of the substances used, the time and cost of the application, and the comparative results, which must also be contrasted with those obtained from a portion of the same field to which no top-dressing was applied.

Reports to be lodged by 1st November 1853.

14. TRIFOLIUM INCARNATUM OR CRIMSON CLOVER, AND TRIFOLIUM MOLINERII.

For an approved Report on the cultivation of either of these Clovers, to determine their uses for Green Forage, by having them sown in summer and autumn, as well as spring—The Gold Medal, or Ten Sovereigns.

Reports to be lodged by 1st November 1853.

15. IMPROVED VARIETIES OF AGRICULTURAL PLANTS.

For an approved Report, detailing the means which may have been successfully employed by the Reporter for obtaining new and superior varieties, or improved sub-varieties, of any of the Cereal Grains, Grasses, Roots, or other Agricultural Plants—The Gold Medal, or Ten Sovereigns.

It is necessary that the varieties and sub-varieties reported upon shall have been proved capable of reproduction from seed, and also that the relation they bear to others, or well-known sorts, should be stated. The Reporter is farther requested to mention the effects that he may have observed produced by different soils, manures, &c., on the plants forming the subjects of report, and how far he may have ascertained such effects to be lasting.

Should any improved variety reported upon be the result of direct ex-

periment by cross-impregnation, involving considerable expense and long-continued attention, a higher premium will be awarded.

Reports to be lodged by 1st November 1853.

16. MANGOLD-WURZEL.

For an approved Report on the cultivation of Mangold-Wurzel in Scotland—The Gold Medal, or Ten Sovereigns.

The Reporter must state the nature and previous preparation of the soil,—the varieties grown,—the period of sowing,—the quantity of seed per acre and mode of sowing,—the time and mode of thinning and cleaning,—the best means of preventing seeding,—the time and manner of storing,—the crop obtained,—and its comparative value for feeding purposes.

Reports to be lodged by 1st May 1854.

17. CABBAGE.

For an approved Report on the cultivation of the Cabbage, and its comparative value for feeding purposes—The Gold Medal, or Ten Sovereigns.

The experiment must be conducted on not less than two acres, and contrasted with a like extent under turnips in the same field. Both lots must have been under one rotation, and must be prepared and manured in the same manner,—and the crop, on each, must be consumed on the ground by the 1st of December.

Reports to be lodged by 1st May 1854.

18. POTATO.

For an approved Report on the means successfully employed by the Reporter for growing and securing a sound Potato Crop—The Gold Medal, or Ten Sovereigns.

The experiment must be conducted on not less than eight acres, planted in equal proportions with two known varieties, each of which shall be treated alike. The previous rotation and condition of the land,—the general management of the crop,—the modes of storing,—and the state of the Potatoes after being two months in store, must be reported. The crop must not be stored before September.

Reports to be lodged by 1st May 1854.

19. VEGETABLE PRODUCTIONS OF INDIA, CHINA, AMERICA, ETC.

For an approved Report on the Hardy and useful Herbaceous Plants, including Grains and Grasses of China, Japan, the Islands of the Eastern Archipelago, the Himalaya Country, the Falkland and South Sea Islands, California, the high north-western districts of America, or any other country, where such climate exists as to induce the belief that the Plants may be beneficially introduced into the cultivation of Scotland—The Gold Medal, or Ten Sovereigns.

Reporters are required to give the generic and specific names of the plants treated of, with the authority for the same—together with the native names, in so far as known; and to state the elevation of the locality and nature of the soil in which they are cultivated, or which they naturally inhabit, with their qualities or uses; and it is further requested, that the descriptions be accompanied, in so far as possible, with specimens of the plants, and their fruit, seed, or other products.

Reports to be lodged by 1st November in any year.

FEEDING OF STOCK.

In the following experiments, the animals selected should be of the same age, sex, and breed, and, as nearly as possible, of the same weight, condition, and maturity. Their live weight before and after the experiment must be stated, and if killed, their dead weight, and quantity of tallow.

20. BEST MODES OF HOUSING FATTENING CATTLE.

For an approved Report on the comparative advantages of fattening Cattle in stalls, in loose houses or boxes, and in sheds or hammels—Twenty Sovereigns.

The Report must detail the comparative results of actual experiments. The same quantities and kinds of food shall be used. Information is required as to the comparative expense of attendance, the cost of erecting the buildings, and any other circumstances deserving of attention.

Reports to be lodged by 1st May 1854.

21. SOILING AND PASTURING CATTLE.

For an approved Report, founded on experiment, on the com-

parative advantages of soiling and pasturing cattle—The Gold Medal, or Ten Sovereigns.

Reports to be lodged by 1st May 1854.

22. DIFFERENT DESCRIPTIONS OF FOOD.

For an approved Report of experiments for ascertaining the actual addition of weight to growing or fattening stock, by the use of different kinds of food—Twenty Sovereigns.

The attention of the experimenter is directed to Turnips, Carrot, Beet, Mangold-Wurzel, Potatoes, Cabbage, as well as to Beans, Oats, Barley, Indian Corn, Flax-Seed, Oil-Cake, or Rape-Cake, and to the effect of warmth and proper ventilation, and the difference between food cooked and raw. The above roots and other kinds of food are merely named as suggestions. Competitors are neither restricted to them, nor obliged to experiment on all of them.

When experiments are made with Linseed and Oil Cake, it is requested that attention be paid to the comparative advantages, economically and otherwise, of the substances in these two states!

Before commencing the comparative experiments, the animals must be fed equally for some time previously.

The progress of different breeds may be compared; this will form an interesting experiment of itself, for Reports of which encouragement will be given.

Reports to be lodged by 1st May 1854.

23. FEEDING ON TURNIPS RAISED WITH DIFFERENT MANURES.

For an approved Report on the progressive improvement and increase in weight (during a period of at least three months) of three lots of cattle, of not fewer than three in each lot, fed in the following manner—

Three fed on turnips grown with guano.

Three fed on turnips grown with farm-yard manure.

Three fed with turnips grown with guano and farm-yard manure.

—Twenty Sovereigns.

The Premium is offered with the view of ascertaining the comparative feeding properties of Turnips grown with guano and with farm-yard manure.

The Turnips must be grown with the different manures on land of

equal quality and in equal condition, and be supplied to each lot of cattle in equal quantities.

Reports to be lodged by 1st May 1854.

24. STORING TURNIPS.

For an approved Report on the results obtained by feeding Cattle on Turnips lifted and stored in November, and by feeding a similar number on the same quantity of Turnips taken from the field during the winter and spring months when required—The Gold Medal, or Ten Sovereigns.

The mode of storing adopted should be detailed.

Reports to be lodged by 1st May 1854.

25. DISEASES OF SHEEP FED ON TURNIPS.

For an approved Report on the nature, symptoms, causes, preventive and remedial treatment, and *post-mortem* appearances, of the Diseases to which Sheep are subject when fed on Turnips, and on the conditions of soil, and management under which such Diseases are most apt to manifest themselves. The popular as well as the scientific names of Diseases to be made use of—The Gold Medal, or Ten Sovereigns.

Reports to be lodged by 1st May 1854.

26. BRAXY IN SHEEP.

For an approved Report on the nature, symptoms, causes, preventive and remedial treatment, and *post-mortem* appearances, of Braxy in Sheep. The popular as well as the scientific names of Diseases to be made use of—The Gold Medal, or Ten Sovereigns.

Reports to be lodged by 1st November 1853.

27. DISEASES OF SWINE.

For an approved Report on the nature, symptoms, causes, preventive and remedial treatment, and *post-mortem* appearances, of the Diseases incident to Swine. The popular as well as the scientific names of diseases to be made use of—The Gold Medal, or Ten Sovereigns.

Reports to be lodged by 1st November 1853.

28. RURAL ECONOMY ABROAD.

For approved Accounts, founded on personal observation, of any useful practice in Rural or Domestic Economy, adopted in other countries, which may seem fitted for being introduced with advantage into Great Britain—The Gold Medal.

The purpose chiefly contemplated by the offer of this Premium is to induce gentlemen who may visit other countries to notice and record such particular practices as may seem calculated to benefit their own country.

Reports to be lodged by 1st November in any year.

§ 2. WOODS AND PLANTATIONS.

1. EXTENSIVE PLANTING.

To the Proprietor who shall, within a period of five years preceding the date of his Report, have planted the greatest extent of ground, not being less than 150 acres, and who shall communicate to the Society an approved Report of his operations, embracing the expense, description of soil, age, kind, and number, per acre, of trees planted, mode of planting, draining, and fencing, and general progress of the plantation, with such observations as his experience may suggest—The Gold Medal.

Reports to be lodged by 1st November in any year.

2. FORMATION AND MANAGEMENT OF YOUNG PLANTATIONS.

For an approved Report of Plantations formed within a period of not more than ten, nor less than five years preceding the date of the Report—The Gold Medal, or Ten Sovereigns.

The Report should comprehend every interesting particular; among others, the exposure, altitude, and general climate of the locality; the previous character and condition of the soil and subsoil; a detailed statement of the expense, including that of inclosing, draining, and fencing, and a specification of the manner in which these operations were performed—the mode of planting adopted—the prevailing weather while planting, and for a month after the operation—the kind of trees planted, and the number of each kind per acre—their relative progress—the proportion of blanks and deaths at the end of three years—the system of management

—the state of the plantations at the date of making the Report,
—and any other observations of interest.

Reports to be lodged by 1st November in any year.

3. GENERAL MANAGEMENT OF PLANTATIONS.

For an approved Report on the Management of Plantations, from the commencement of the first thinning till the period of yielding full-grown timber—The Gold Medal, or Ten Sovereigns.

The Reporter's attention should be directed to the following points: The annual progress of the different sorts of trees—the effects of altitude and exposure—the general advantages of shelter—the mode of thinning and pruning adopted—the uses and value of the thinnings—the plan of registry and of valuing, or a specimen of the method in which the forester's book is kept—the valuation at the time of the Report—together with such general remarks as may be thought useful.

The Report is not expected to embrace the formation and early management further than the description of soil, kinds of plants, whether mixed or in masses, together with a note of the expense from the time of planting to the commencement of the first thinning, in so far as such information is in the possession of the Reporter.

Reports to be lodged by 1st November in any year.

4. USES AND VALUE OF TIMBER.

For an approved Report, founded on practical observation and experience, on the economic uses and comparative value of different descriptions of Timber grown in Scotland—The Gold Medal, or Ten Sovereigns.

The object of the Society in offering this Premium, is to elicit information on, and direct attention to, the comparative value of different descriptions of timber, and the purposes to which they can most advantageously be applied,—whether ship-building——dwellings—furniture—machinery of various kinds—fences—pit-props,—or chemical, manufacturing, and other useful purposes.

The Reporter is required to state the popular and scientific names of the different kinds of Trees, the localities on which they are grown, and, in a general manner, the soil and subsoil, altitude, exposure, and mode of management.

He must specify the proper age and time for cutting different sorts of timber, the mode of seasoning, and the period which may have

elapsed between felling and using. He must also give the present market value of the various timbers, and information as to the sorts he considers might be cultivated with advantage in different localities.

The attention of Competitors is directed to the differences which are supposed to exist in the quality of the timber in natural and in planted forests.

Reports to be lodged by 1st November in any year.

5. PRESERVATION OF TIMBER.

For an approved Report on the best mode of treating Timber, (the growth of Scotland,) with the view of preventing warping—injury from insects or worms—or premature decay—The Gold Medal, or Ten Sovereigns.

The Report must be founded on actual experiment and observation. The means employed must be practically explained—whether by immersing the trees or plants in fresh or salt water,—in solutions of saline, earthy, or metallic bodies, or in other matters—as also the best mode of applying the preservative material, whether by the aid of heat or otherwise, so that the timber may be thoroughly penetrated.

Reports to be lodged by 1st November in any year.

6. PLANTING WITHIN THE INFLUENCE OF THE SEA, OR ON BARREN TRACTS.

For an approved Report on successful Planting within the influence of the sea, or on exposed sterile tracts, founded on observation of the habits and appearance of the different sorts of trees considered as best suited for such situations—The Gold Medal, or Ten Sovereigns.

Information is particularly desired regarding the species and varieties of trees calculated for growing in situations unfavourable to most of the more generally cultivated sorts, as in bleak heaths, barren sandy links, exposed maritime situations; and the northern slopes of hills.

The Reporter is required to specify the extent and mode of drainage and fencing—the nature of the soil and subsoil—the elevation and exposure of the locality—and its distance from the sea; and, if in his power, he should notice the underlying rocks, and the geological features of the district.

Reports to be lodged by 1st November in any year.

7. ARBORETUM.

For an approved Report on the most varied, extensive, and judiciously arranged collection of hardy, or supposed hardy, forest and ornamental Trees, either *species* or marked *varieties*, of not less than five years' standing, and in Scotland—The Gold Medal, or Ten Sovereigns.

The Arboretum must be formed so as to afford ample space for the full development of the specimens. The Report must specify the nature of the locality—its altitude and exposure—the description and previous preparation of the soil—the date of planting—the system of draining—fencing—and pruning—and any other circumstances which may be supposed to influence the growth of the plants ; the number of failures, with the periods when, and circumstances under which these occurred, must also be reported. Information should be added, when in the Reporter's possession, as to the age and average height of the specimens—and whether they are seedlings, cuttings, layers, or grafted plants—and, if possible, the stock on which they have been grafted.

The Report should be accompanied with a correct list, containing the names of the different species and varieties, with an authority for each, and a plan shewing the disposition of each specimen. The trees in the Arboretum must be numbered and named relative to the list and plan.

Reports to be lodged by 1st November in any year.

8. DISEASES OF FOREST TREES.

For an approved Report on the diseases incident to Forest Trees, and the injuries they sustain from the attacks of Insects—The Gold Medal, or Ten Sovereigns.

The Reporter is required to state the kinds of Trees most generally liable to be attacked—the parts first affected—the age of the Tree and period of the season when first observed—the state of the drainage—the altitude and exposure of the locality, and its geological formation—the nature of the soil and subsoil—when and how the Trees were pruned—the remedies, preventive and remedial, which may have been tried. Information is required as to the causes of decay—whether attacks of insects, or cryptogamic growth—and how far either of these causes may have been induced by the previous sickly or stunted condition of the Tree. Attention is directed to the Beech, Larch, Silver Fir, and White Pine (*Pinus Strobus*), and to the Coniferæ generally, and parti-

cularly to the stripping of the leaves from Scotch and other Pines by the pine leaf caterpillar.

Reports to be lodged by 1st November in any year.

9. PLANTING ON PEAT MOSS.

For an approved Report on Plantations, of not less than eight years' standing, formed on deep peat moss—The Gold Medal, or Ten Sovereigns.

It being understood that large tracts of peat moss have been profitably planted in England and Holland, it is considered desirable to obtain information on the subject. The Premium is strictly applicable to deep peat or flow moss; and it is desirable that the condition of the moss in its original state, as well as at the date of the Report, should, if possible, be stated.

The Reporter must describe the mode and extent of the drainage, and the effect it has had in subsiding the moss—the trenching, levelling, or other preliminary operations that may have been performed on the surface; the mode of planting, kinds, sizes, and number of trees planted per acre, and their relative progress and value, as compared with plantations of a similar age and description, grown on other soils in the vicinity.

Reports to be lodged by 1st November in any year.

10. WILLOWS.

For an approved Report on the more extended cultivation of Willows, for basket and other industrial purposes—The Medium Gold Medal, or Five Sovereigns.

The Report must state the nature of the soil and subsoil—the time and mode of planting—the expense per acre—the best varieties—and the most profitable applications.

Reports to be lodged by 1st November 1853.

11. FOREST TREES OF RECENT INTRODUCTION.

For an approved Report on the more extended introduction of hardy useful or ornamental Trees, which have not hitherto been generally cultivated in Scotland—The Gold Medal.

The Report should specify, as distinctly as possible, the kind of trees introduced. The nature of the plantation should likewise be described, as to soil, exposure, shelter, and elevation above the level of the sea. The adaptation of the trees for use or ornament, and

their comparative progress, should be mentioned. Attention is directed to the introduction into use of any tree as a nurse in young plantations, which, by growing rapidly for several years, and attaining maturity when at the height of 20 or 25 feet, might realise the advantages without the evils of thick planting.

Reports to be lodged by 1st November in any year.

12. HEDGES.

For an approved Report on the formation of Hedges, and the comparative value of Plants, which may be employed for inclosures —The Medium Gold Medal, or Five Sovereigns.

The Report must specify the manner in which the fence has been formed—the date and mode of planting—and age of plants—how protected while young—general progress and management—age when first cut—form in which kept—and reasons why such form was adopted—together with the nature of the soil and subsoil—the altitude and exposure. The Report to specify all expenses incurred.

The attention of the Reporter may further be directed to evergreen fences for ornamental as well as useful purposes.

Reports to be lodged by 1st November 1853.

13. BARK OF TREES.

For an approved Report on the properties and comparative value of the Barks of the various species of Trees and Shrubs for tanning and other commercial purposes—The Gold Medal, or Ten Sovereigns.

Reports to be lodged by 1st November in any year.

14. INTRODUCTION OF SEEDS.

To the person who shall send to the Society seeds capable of germination, either of new or recently-introduced Coniferæ, or of the rarer kinds of forest trees—The Medium Gold or Silver Medal.

Before the Premium is awarded, the number of seedling Plants of each species raised by the Society shall not have been less than 50. Seeds of Coniferæ may be sent home in the cones, wrapped in brown paper, packed in a box, to be kept in a cool, airy part of the cabin, but on no account in the hold, nor in close tin

cases. In the event of seeds being separated from the cones, hasty and severe heating in extracting them, should be carefully avoided. Seeds of Hardwood may be packed in brown paper, or in sphagnum (moss), or they may be mixed with soil and placed in strong boxes.

Reports to be lodged by 1st November in any year.

As some of the experiments, suggested in the foregoing section, require to be conducted for several years before definite results regarding every particular can be arrived at, occasional communications, detailing facts of importance, will be received and acknowledged by honorary rewards.

§ 3. WASTE LANDS.

1. IMPROVEMENT OF WASTE LAND BY TILLAGE.

1. To the Proprietor or Tenant in Scotland who shall transmit to the Society an approved Report of having successfully improved and brought into profitable tillage, within five years preceding the date of his communication, not less than fifty acres of waste Land,—The Gold Medal, or Ten Sovereigns.

2. To the Tenant in Scotland who shall transmit to the Society an approved Report of having, within three years preceding the date of his Report, successfully improved and brought into profitable tillage, not less than twenty acres of waste Land on the same farm—The Medium Gold Medal, or Five Sovereigns.

3. To the Tenant who shall transmit an approved Report of a similar improvement of not less than ten acres—The Silver Medal.

The Report may comprehend such general observations on the Improvement of Waste Lands as the writer's experience may lead him to make; but they are required to refer especially to the land reclaimed (which, if not in one continuous tract, must be in fields of considerable extent), to the nature of the soil, the previous state and probable value of the ground, the obstacles opposed to its improvement, the mode of management adopted, and the produce and value of the subsequent crops. The land must have borne one crop of grain, at least, previous to the year in which the Report is made. The Reports must be accompanied

by a *detailed statement of the expenditure and return*, and by a ertified measurement of the ground.

Reports to be lodged by 1st November in any year.

2. IMPROVEMENT OF WASTE LAND WITHOUT TILLAGE.

1. To the Proprietor or Tenant in Scotland who shall transmit to the Society an approved Report of having, within three years preceding the date of his Report, successfully improved the pasturage of not less than thirty acres, by means of Top-Dressing, Draining, or otherwise without tillage, in situations where tillage may be inexpedient—The Gold Medal, or Ten Sovereigns.

2. To the Proprietor or Tenant who shall transmit an approved Report of a similar improvement of not less than ten acres—The Silver Medal.

Reports must state the particular mode of management adopted, the elevation and nature of the soil, its previous natural products, and the changes produced.

Reports to be lodged by 1st November in any year.

§ 4. AGRICULTURAL MACHINERY.

1. INVENTION OR IMPROVEMENT OF IMPLEMENTS OF HUSBANDRY.

For approved Reports of such inventions or improvements by the Reporters of any Agricultural Implement or Machine as shall be deemed by the Society of public utility—Medals or Sums not exceeding Fifty Sovereigns.

Reports must be accompanied by drawings and descriptions of the implement or machine, and, if necessary, by a model. Models, if approved of, will be deposited in the Society's Museum, and the expense of their construction will be repaid to the Inventor. When machines or models are transmitted, it must be stated whether they have been elsewhere exhibited or described.

Models and descriptions may be lodged at any time with the Secretary. Models on a scale of 3 inches to the foot will be preferred.

2. REAPING MACHINES.

For an approved Report and description of an efficient Reaping

Machine, the price of which shall not exceed £20—The Gold Medal, or Ten Sovereigns.

Reports to be lodged by 1st November 1853.

3. MACHINE FOR PREPARING AND MANUFACTURING CLAY.

For an approved Report on the Machinery best adapted to produce, by one operation, or an uninterrupted series of operations, pipes or tiles from clay in a rough state—Twenty Sovereigns.

The object of the Society is to effect economy of labour, by dispensing, if possible, with the separate application of power, as generally employed at present in milling, screening, and moulding the clay, and to substitute for these a continuous process, from the entrance of the rough clay to the delivery of the moulded tile or pipe.

Reports to be lodged by 1st November 1853.

4. MACHINERY FOR FLAX.

For an approved Report on Machinery for preparing Flax—Twenty Sovereigns.

The Report, with Drawing or Models, may embrace all or any part of the Apparatus or Machinery required in the preparation of Flax, from the separation of the seed to the state in which it is delivered to the heckler.

Reports to be lodged by 1st November 1853.

5. BEST CONSTRUCTION OF PLOUGH.

For an approved Report on different descriptions of Ploughs for different purposes—The Gold Medal, or Ten Sovereigns.

The attention of Competitors is particularly called to the importance of securing increase of depth without increase of draught. The Reporter should consider the merits of the Swing Plough, as compared with English Wheel Ploughs, such as Busby's or Howard's, and the comparative advantages of the Scotch Ploughs which give a high crested shoulder, and which give a rectangular shoulder. The best descriptions of subsoil and trench Ploughs should also be adverted to.

Reports to be lodged by 1st November 1853.

6. THRASHING MACHINES.

For an approved Report and description of a Thrashing Machine, embracing the best combination of the English high speed drum, with the Scotch apparatus for shaking, dressing, &c., in Machine thrashing. The Report must be accompanied with Drawings of the arrangements—Twenty Sovereigns.

Reports to be lodged by 1st November 1853.

7. POTATO LIFTER.

For an approved Report and description of an Implement calculated to lift Potatoes more expeditiously and economically than the Graip, and more efficiently than the Common Plough—The Medium Gold Medal, or Five Sovereigns.

Reports to be lodged by 1st November 1853.

8. APPLICATION OF IRON.

For an approved Report on the more general application of iron to the purposes of the Farm, as a material for carts, waggons, tram-rails, flakes, stable and byre fittings, shed-pillars, rick-stands, &c., &c.—The Gold Medal, or Ten Sovereigns.

Reports to be lodged by 1st November 1853.

CLASS II.

LIVE STOCK—DISTRICT COMPETITIONS.

§ 1. CATTLE.

DISTRICTS.

1. *The Parishes of Rhynie, Gartly, Huntly, Cairnie, Forgue, and Drumblade, and that part of the Parish of Cabrach, in the County of Aberdeen.*
2. *The County of Kinross.*
3. *The District in the West of Perthshire, comprehending the Parishes of Callander, Kilmadock, Kincardine, Comrie, Balquhidder, Aberfoyle, and Part of Mon-*

teith, with that part of the District of Breadalbane, comprising Glenlochy, Glendochart, and Glenfalloch.

4. *The County of Fife.*
5. *The County of Wigtown.*
6. *The County of Linlithgow.*
7. *The District of Nithsdale, comprehending the Parishes of Kirkconnel, Sanquhar, Durrisdeer, Morton, Closeburn, Kirkmahoe, Kirkmichael, Dumfries, Carlaverock, Tinwald, Torthorwald, Holywood, Dunscore, Glencairn, Keir, Penpont, and Tynron, in the County of Dumfries; and Troqueer, Terregles, and Irongray, in the Stewartry of Kirkcudbright.*
8. *The Districts of Ythanside and Formartine in the County of Aberdeen.*
9. *The County of Inverness.*

Class I.

1. For the best Bull, of any pure Breed, not exceeding eight years old, belonging to a Proprietor or Factor—The Silver Medal.

2. For the Best Bull, of any pure Breed, calved before 1st January 1851, and not exceeding eight years old, belonging to a Tenant or Proprietor farming the whole of his own lands—Eight Sovereigns.

3. For the second best—Four Sovereigns.

4. For the best Bull of any pure Breed, calved after 1st January 1851, belonging to a Tenant or Proprietor farming the whole of his own lands—Five Sovereigns.

Class 2.

1. For the best pair of Heifers, of any pure Breed, of two years old (if Highland Breed, three years), belonging to a Tenant or a Proprietor farming the whole of his own lands—Five Sovereigns.

2. For the second best—Three Sovereigns.

The Society's Premiums are granted to each District for three alternate years, it being understood, as a condition, that the Districts shall, in the two intermediate years, continue the Competitions, by offering a sum not less than one-half of that given by the Society.

In 1853,

Nos. 1, 2, 3, 4, 5, 6, 7, and 8, are in Competition for the Society's Premiums.

No. 9 will compete for Local Premiums.

Conveners of Committees.

FOR THE FIRST DISTRICT—The Duke of Richmond, and Robert Simpson, Esq. of Cobairdy.

FOR THE SECOND DISTRICT—Sir Graham Graham Montgomery of Stanhope, Bart., and Charles Stein, Esq. of Hattonburn.

FOR THE THIRD DISTRICT—John Burn Murdoch, Esq. of Gartincaber.

FOR THE FOURTH DISTRICT—The Earl of Leven and Melville, and James B. Fernie, Esq. of Kilmux.

FOR THE FIFTH DISTRICT—Robert Vans Agnew, Esq. of Barnbarroch.

FOR THE SIXTH DISTRICT—The Earl of Rosebery, and George Falconar, Esq.

FOR THE SEVENTH DISTRICT—The Duke of Buccleuch, and William Maxwell, Esq. of Carruchan.

FOR THE EIGHTH DISTRICT—Rear Admiral the Hon. Wm. Gordon, M.P., and John Leith Ross, Esq. of Arnage.

FOR THE NINTH DISTRICT—Arthur Forbes, Esq. of Culloden.

RULES OF COMPETITION.

1. The Members of the Society connected with the respective Districts are appointed Committees of superintendence for regulating the Competitions; three Members to be a quorum.

2. The Convener of each District will summon a meeting of Committee, not later than the 20th of May, for the purpose of determining the time and place of Competition, the nomination of Judges, and other preliminary arrangements. The time and place will be publicly intimated by Conveners, in such a manner as may appear to them most effectual. The Meetings are open to all Members of the Society.

3. The Competitions must take place between the 1st of June and the 1st of October. The animals exhibited must belong to one of the pure Breeds—Short-horn—Ayrshire—Polled Galloway, Angus, or Aberdeen—Highland. The Bulls may be of one Breed, and the Heifers of another. The Committee shall select the Breed, and specify it in the returns.

4. Stock of an inferior description, or which does not fall within the prescribed regulations, shall not be placed for Competition. The Premiums shall not be divided. No Money Premium shall be adjudged, unless there are three Lots exhibited, and not more than one-half unless there are six. A Competitor may exhibit two Lots in each Class. For the Medal, two Lots authorise an award.

5. An animal which has gained the Society's first Premium at a previous District or General Show is inadmissible, except for the Medal; and one

which has gained a second Money Premium can only thereafter compete for the first. The same animal cannot be entered for the Medal and the Money.

6. A Tenant may compete with Proprietors and Factors for the Medal with a Bull which has gained the first Money Premium at a previous Show. When there is any doubt as to whether a Competitor should be ranked as a Proprietor or a Tenant, the point is left to the decision of the Local Committee.

7. A Bull, the property of two or more Tenants, may compete, although the Exhibitors may not be joint Tenants. Bulls not belonging to the District may compete, provided they are left within it for service.

8. Bulls for which the Money Premiums are awarded must serve in the District at least one season; and the rate of service may be fixed by the Committee.

9. Blank Reports and Returns will be furnished to the Conveners of the different Districts. These must, in all details, be completed and lodged with the Secretary on or before the 15th of October next.

10. It is to be distinctly understood, that in no instance does any claim lie against the Society for expenses attending a Show of Stock, beyond the amount of the Premiums offered; and that all Premiums not applied for within two years from the term of payment (10th February 1854), shall be forfeited.

11. A Report of the Competition and Premiums awarded at the *intermediate* Local Shows, in the several Districts, signed by a Member of the Society, must be transmitted to the Secretary, on or before the 15th of October in each year.

§ 2. DRAUGHT HORSES.

DISTRICT.

The District in connexion with the Glasgow Agricultural Society.

Mark Sprot, Esq., of Garnkirk, *Convener of Committee.*

Forty Sovereigns, of which twenty are contributed by the Local Association, will be awarded as follows:—

1. For the best Stallion, for agricultural purposes, not under three years and nine months, and not above twelve years old—Twenty-five Sovereigns.

2. For the best Mare, for agricultural purposes—Ten Sovereigns.

3. For the best Filly, foaled after 1st January 1851—Five Sovereigns.

RULES OF COMPETITION.

1. The Members of the Society in the District are appointed a Committee of Superintendence, as in No. 1 of the Regulations for the Cattle Competitions; and they will be convened on or before the 10th of March, in the same manner and for purposes similar to those indicated in the said Regulations.

2. The time and place of Competition to be fixed by the Convener, with

the concurrence of the Committee, and to be published by him in due time, and in such manner as shall be thought most effectual for the information of those interested.

3. If fewer than three animals be exhibited in any class, half the Premium only can be awarded. The Regulations for Cattle Shows, in regard to the previous intimation to the Committee and Competitors—the power of the Committee to exclude stock, if the animals produced shall be of inferior character—extra expenses—the period within which Premiums must be applied for, and the manner in which the Report is to be certified and transmitted to the Society, are severally applicable to the Premiums for Horses. Evidence must be produced that the Prize Stallions have had produce. Mares must have foals at their feet, or be in foal, and in the latter case, payment of the Premium will be deferred till Certificate of birth.

ENTIRE COLTS.

NOTE.—The Society being anxious to promote the improvement of Draught Horses by encouraging the rearing of entire Colts, Stallion premiums are limited to a period of two years, and succeeded by premiums for other two years within the same District for entire Colts.

1. *The District of Annandale.*

Viscount Drumlanrig, M.P., *Convener of Committee.*

2. *The County of Dumbarton.*

Alex. Smollett, Esq., of Bonhill, M.P., *Convener of Committee.*

1. For the best entire Colt, for agricultural purposes, foaled after 1st January 1851—Six Sovereigns.

2. For the best entire Colt, for agricultural purposes, foaled after 1st January 1852—Four Sovereigns.

If fewer than three animals be exhibited in either class, only half the Premium can be awarded.

§ 3. SHEEP.

1. LEICESTER BREED.

DISTRICTS.

1. *The County of Forfar.*
2. *The County of Banff, and that part of the County of Aberdeen in connexion with the Banffshire and Turriff District Agricultural Association.*
3. *The District of Buchan in Aberdeenshire.*
4. *The Counties of Edinburgh and Haddington.*

1. For the best Tup of any age, belonging to a Proprietor or Factor—The Silver Medal.

2. For the best Tup of any age—Five Sovereigns.

3. For the best two Shearling Tups—Five Sovereigns.

4. For the best Pen of five Ewes, not less than two Shear—Five Sovereigns.

5. For the best pen of five Gimmers or Shearling Ewes—Four Sovereigns.

The Money Premiums are restricted to Tenants and Proprietors farming their whole properties.

In 1853,—

Nos. 1 and 2 are in competition for the Society's Premiums.

Nos. 3 and 4 will compete for Local Premiums.

Conveners of Committees.

FOR THE FIRST DISTRICT—Sir James Ramsay of Bamff, Bart., and William Macdonald Macdonald, Esq. of St Martins.
FOR THE SECOND DISTRICT—Alexander Morison, Esq. of Bognie.
FOR THE THIRD DISTRICT—James Ferguson Esq. of Kinmundy.
FOR THE FOURTH DISTRICT—James Aitchison, Esq. of Alderston.

2. CHEVIOT BREED.

DISTRICTS.

1. *The Districts of Annandale and Eskdale in Dumfries-shire, and Liddesdale in Roxburghshire.*
2. *The Island of Skye.*
3. *The County of Roxburgh.*

1. For the best Tup of any age, belonging to a Proprietor or Factor—The Silver Medal.

2. For the best Tup of any age—Five Sovereigns.

3. For the best two Shearling Tups—Five Sovereigns.

4. For the best Pen of Five Ewes, not less than Two Shear—Five Sovereigns.

5. For the best Pen of Five Gimmers or Shearling Ewes—Four Sovereigns.

The Money Premiums are restricted to Tenants and Proprietors farming their whole properties.

In 1853,—

Nos. 1 and 2 are in competition for the Society's Premiums.

No. 3 will compete for Local Premiums.

Conveners of Committees.

For the First District—Robert Johnstone Douglas, Esq. of Lockerby.
For the Second District—Lord Macdonald, or his Factor.
For the Third District—John Ord, Esq. of Muirhouselaw.

3. BLACK-FACED BREED.

DISTRICTS.

1. *The adjoining parts of the Counties of Perth, Argyll, and Inverness, under Black-faced Sheep.*
2. *The Islands of Lewis and Harris.*
3. *The District of Cowal in Argyllshire.*

1. For the best Two Tups, not exceeding four Shear, belonging to a Proprietor, or to a Tenant paying more than £150 of yearly rent—Five Sovereigns.

2. For the best Two Tups, not exceeding Four Shear, belonging to a Tenant paying not more than £150 of Rent—Five Sovereigns.

3. For the best Pen of five Gimmers or Shearling Ewes, belonging to a Proprietor, or to a Tenant paying more than £150 of Rent—Four Sovereigns.

4. For the best Pen of five Gimmers or Shearling Ewes, belonging to a Tenant paying not more than £150 of Rent—Four Sovereigns.

In 1853,—

Nos. 1 and 2 are in competition for the Society's Premiums.

No. 3 will compete for Local Premiums.

Conveners of Committees.

For the First District—Sir Robert Menzies of Menzies, Bart.
For the Second District—Sir James Matheson of Lewis, Bart., M.P.
For the Third District—Robert Maclachlan, Esq. of Maclachlan.

RULES OF COMPETITION.

1. The Members of the Society in the several Districts are appointed Committees of Superintendence, as in Nos. 1 and 2 of the Regulations for Cattle Competitions, and they shall be convened by their respective Conveners on or

before the 20th of May, in the same manner, and for the same purposes as specified in the said Regulations.

2. The Competitions shall take place between the 1st of June and the 1st of October, and the time and place must be publicly intimated by each Convener within his District.

3. Tups shall have served the usual number of Ewes, for at least three weeks during the previous season. All prize Tups must serve within the Districts during the following seasons. The Competitions are open to Tups not belonging to the Districts, provided they are left to serve in them. Ewes must have reared Lambs during the season. Ewes and Gimmers must be taken from regular breeding hirsels.

4. Animals must not be clipped earlier, nor otherwise, than the Stock to which they belong.

5. The Premiums shall not be divided. No Money Premium shall be adjudged unless there are three Lots exhibited, and only one-half if there are not six Lots. Each Competitor may show two Lots. For the Medal, two Lots authorise an award. The other regulations for Cattle Competitions—in regard to the placing of Stock—the exclusion of Animals which have gained Premiums at previous shows—the right of a Tenant, under certain circumstances, to compete for the Medal—the regulation as to expenses—the period within which Premiums must be applied for—and the manner in which the Reports must be certified and transmitted—are applicable to the Premiums for Sheep.

6. The Society gives these Premiums in alternate years for three Competitions in each District, if, during the intervening years, Premiums are awarded by the District to an amount not less than one-half of the Society's Premiums, and for the same description of Stock.

7. Blank Reports and Returns of Competitions will be furnished to the Conveners of Districts. These must be accurately filled up in all details, signed by the Convener, and transmitted to the Secretary by the 15th of October.

4. SHEARING SHEEP.

The Silver Medal will be given to the best Sheep-shearer in each of the Districts in which the Premiums for sheep are in operation.

CONDITIONS.

1. A guarantee must be lodged with the Secretary by the 20th of May, that Money Premiums will be awarded at each Competition, to the amount of not less than £2.

2. The District Conveners for the Sheep Premiums shall fix the time and place of Competition, and make all necessary arrangements.

3. The Medal shall not be awarded unless there are three Competitors; and it shall always accompany the highest Money Premium; if two or more Lots appear to be equally well executed, preference shall be given to that executed within the shortest time.

4. The Conveners shall report the particulars of the Competition and the award of the Judges to the Society, along with the Report of the Sheep Premiums in the District.

§ 4. SWINE.

The District in connexion with the Penicuick Agricultural Association.

CONVENER—The Right Hon. Sir George Clerk, of Penicuik, Bart.

1. For the best Boar, belonging to a Proprietor or Factor—The Silver Medal.
2. For the best Boar—Four Sovereigns.
3. For the second best—Two Sovereigns.
4. For the best Breeding Sow—Three Sovereigns.
5. For the second best—One Sovereign.

The Money Premiums are restricted to Tenants, and Proprietors farming their whole properties.

The Regulations for Cattle Competitions, pages 35 and 36, are to be held as applicable to the Premiums for Swine; and the Convener and Committee of the Society's Members in the District are accordingly referred to them.

CLASS III.

DAIRY PRODUCE.

DISTRICT.

The County of Renfrew.

CONVENER—Archibald Campbell, Esq. of Blythswood.

1. BUTTER.

To the Tenant, or Proprietor farming the whole of his own lands in the District, who shall exhibit the best sample of cured Butter, not less than 14 lbs.—Three Sovereigns.

For the second best—Two Sovereigns.

For the third best—One Sovereign.

To the Proprietor in the District who shall exhibit the best sample of Butter—The Silver Medal.

2. CHEESE.

To the Tenant, or Proprietor farming the whole of his own lands in the District, who shall exhibit the best couple of Cheeses made from Sweet Milk—Three Sovereigns.

For the second best—Two Sovereigns.

For the third best—One Sovereign.

To the Proprietor in the District who shall exhibit the best Cheese—The Silver Medal.

CONDITIONS.

1. The Members of the Society, resident within the District, are appointed a committee of superintendence, for the purposes expressed in the Regulations for cattle competitions.

2. Competitors must certify that the Butter and Cheese exhibited by them are average specimens of the produce of their Dairies in 1853; and that the quantity produced during the season has not been less than 1 cwt. of butter, or 2 cwt. of cheese. The committee shall fix such General Regulations as they may consider proper—and, in particular, the time and place of competition. In the event of two or more competing Lots being deemed equal in quality, the Premium will be awarded to the competitor who shall have cured the larger quantity. The successful competitors, before receiving the Premiums, are required to transmit to the Secretary a detailed Report of the whole process followed by them in the manufacture of their Butter.

A Report of the award of the Premiums to be lodged with the Secretary of the Society on or before the 1st November 1853.

CLASS IV.

CROPS AND CULTURE.

1. SEEDS.

The Society, with a view of aiding Local Associations in the improvement of the different Grains, Grasses, Roots, &c., offers the Silver Medal to the growers of the best Seeds of the varieties which may be considered most adapted for the districts in which they are raised, and for each of which a Premium of Two Pounds has been awarded in the district.

THE FOLLOWING DISTRICTS HAVE APPLIED FOR MEDALS:—

1. County of RENFREW: Convener, Colonel Macdowall of Garthland.

1. Any variety of White Wheat.
2. Sandy Oats.
3. Any variety of Field Beans.
4. Any variety of Potato.

2. Counties of DUMFRIES and KIRKCUDBRIGHT: Convener, James Macalpine Leny, Esq. of Dalswinton.

1. Any variety of White Wheat.
2. Any variety of Barley.
3. Potato Oats.
4. Sandy Oats.
5. Any other variety of Early Oats.
6. Any other variety of Late Oats.
7. Perennial Rye Grass.
8. Any variety of Potato.

3. District of KINTYRE: Convener, Smollett Montgomery Eddington, Esq. of Glencreggan.

1. Sandy Oats.
2. Bere.
3. Mazagan Beans.
4. Perennial Rye Grass.

4. District of BUCHAN: Convener, James Ferguson, Esq. of Kinmundy.

1. Early Berlie Oats.
2. Perennial Rye Grass.

5. County of HADDINGTON: Convener, James Aitchison, Esq. of Alderston.

1. Red Wheat.
2. Chevalier Barley.
3. Any other variety of Barley.
4. Potato Oats.
5. Late Angus Oats.
6. Hopetoun Oats.
7. Any other variety of Oats.
8. Any variety of Field Beans.

6. District of WESTER ROSS: Convener, Sir Evan Mackenzie of Kilcoy, Bart.

1. Any variety of White Wheat.
2. Any variety of Barley.

3. Any variety of Oats.
4. Perennial Rye Grass.

7. District of FORRES: Convener, C. L. Cumming Bruce, Esq. of Roseisle, M.P.

1. Any variety of White Wheat.
2. Any variety of Barley.
3. Any variety of Early Oats.
4. Any variety of Late Oats.
5. Perennial Rye Grass.

8. County of INVERNESS: Convener, Arthur Forbes, Esq. of Culloden.

1. Any variety of White Wheat.
2. Any variety of Barley.
3. Any variety of Oats.
4. Perennial Rye Grass.

9. County of NAIRN: Convener, James C. Brodie, Esq. of Lethen.

1. Berlie Oats.
2. Perennial Rye Grass.

10. County of BANFF, and that part of the County of ABERDEEN in connexion with the *Banffshire and Turriff District Agricultural Association*: Convener, Alexander Morison, Esq. of Bognie.

1. Any variety of Early Oats.
2. Chevalier Barley.
3. Any other variety of Barley.
4. Perennial Rye Grass.

CONDITIONS.

1. In each District the Convener, appointed by the Society, will fix the time and place of Competition, appoint the Judges, and make all other necessary arrangements, in concurrence with the other Members of the Society, and the Local Association of the District. Conveners will be furnished with blank schedules for returning the awards.

2. The quantity shewn in Competition by each Grower must not be less than three quarters of each variety of grain, two quarters of Beans, Pease, Vetches, or Grass Seeds, and half a ton of Potatoes. There must at least be

two Competitors. The sum of £2, awarded by the District, may be divided into two Premiums.

3. The Judges shall be guided in their awards—*1st*, By the purity of the Seed; *2d*, By its freeness from extraneous Seeds; and, *3d*, Where there is an equality in these respects, by the weight. Competitors must have previously certified that the Grain, Grasses, Beans, &c., exhibited, are fair average specimens of what have been thrashed, and that the lots have in no way been picked or sorted.

4. Each Competitor to whom a medal shall be adjudged, must immediately transmit to the Society's Museum, George IV. Bridge, Edinburgh, free of expense, a sample of the Seed. If it is grain or grass, the quantity must not be less than two quarts.

5. The returns must shew, as accurately as possible, the produce per imperial acre, as also the altitude, exposure, and nature of the soil on which the crops were raised, together with the dates of sowing and reaping, and, in the case of grain or grass-seed, the weight per bushel. The varieties, for which Premiums have been given, must be named. Reports of the several Competitions must be lodged by the 15th of October.

The Medals will be continued in each District for five consecutive years. Applications from other Districts must be lodged with the Secretary of the Society by 1st of November next.

2. TURNIP SEED.

(1.) PURPLE TOP SWEDE—GREEN TOP YELLOW—PURPLE TOP YELLOW.

DISTRICT—THE COUNTIES OF EDINBURGH, HADDINGTON, AND LINLITHGOW.

For the most approved quality of Seed of the following varieties of Turnip,—Purple Top Swede (Skirving), Green Top Yellow Bullock, Purple Top Yellow Bullock, grown in the Lothians in 1854, from the seed of mature selected and transplanted roots, the quantity of each variety raised being not less than Ten Quarters—The Gold Medal, or Ten Sovereigns, for each variety.

(2.) GREEN TOP YELLOW.

DISTRICT—THE ISLAND OF ORKNEY.

For the most approved quality of Green Top Yellow Turnip Seed (Pollexfen variety), grown in Orkney, in 1854, from the seed of mature selected and transplanted roots, the quantity raised being not less than Three Quarters. The Medium Gold Medal, or Five Sovereigns.

There being reason to apprehend that Turnip Seed degenerates when raised from roots imperfectly developed, the seed must be sown

not later than the 15th of July. At least two acres of each variety intended for competition must be grown in 1853, from the same seed for a general crop, which, when at maturity, will, along with the seed crop, be inspected by a Committee of the Society, who will be guided by the purity of the stock; the symmetry and size of the roots; the apparent hardiness of the variety; and its apparent capability of yielding a bulky crop.

After the inspection, 20 roots of each crop (general and seed crop), must be sent to the Society's Museum, free of charge.

Intimation of intention to compete must be lodged with the Secretary by the 20th of July, accompanied by a certificate that the seed was sown by the 15th.

When a party intends to compete for more than one sort, the different varieties must be properly isolated, and in no case shall two sets be allowed to stand for seed contiguously.

A certified statement of the extent of ground under crop, and of the quantity of clean marketable seed harvested, must be lodged with the Secretary on or before the 1st of November 1854, and at same time a sample of not less than two quarts of the seed must be transmitted, free of charge, to the Museum.

3. GREEN CROPS ON SMALL POSSESSIONS.

With the view of improving the cultivation of small possessions, by the introduction of Green Crops, the following Premiums, one-half of which is contributed by the respective Districts, will be awarded :—

For the best Green Crop—Three Sovereigns.
For the second best do. —Two-and-a-half Sovereigns.
For the third best do. —One-and-a-half Sovereign.
For the fourth best do. —One Sovereign.

DISTRICTS.

1. The Parishes of KENMORE and KILLIN, including the portion of the Parish of WEEM on Loch Tay.—Convener, The Marquis of Breadalbane.
2. The Island of SKYE.—Convener, Lord Macdonald, or his Factor.
3. The *Quoad Sacra* Parish of NEW PITSLIGO.—Convener, Sir John Stuart Forbes of Pitsligo, Bart.

CONDITIONS.

1. The competition to be limited to Tenants occupying not more than 40 acres of land.

2. The quantity of ground under Green Crop to be fixed by the Conveners,—at least one-half of the Green Crop to be Turnips, and that portion which is in Green Crop in 1853 should be sown out, with sufficient quantities of Clovers and Rye Grass, with the White Crop in 1854.

3. The names of intending Competitors must be intimated to the Conveners appointed by the Society, on or before the 15th day of May 1853; but after that date no additional name shall be received.

4. Should there be only one Competitor, the Committee may allow him such portion of one of the Premiums as they may think merited. The Committee may withhold all or any portion of the Premiums.

5. The Inspectors, to be fixed by the respective Conveners with the assistance of such other Members of the Society as may attend, shall decide the Premiums.

6. The awards to be intimated to the Secretary of the Society on or before the 1st of November in each year; and Conveners are particularly requested to state in their reports the proportion of each Lot cropped, as above mentioned, and to offer any suggestions which they may consider of importance.

Similar Premiums will be given in five additional Parishes for 1854, and three succeeding years, on guarantees for the payment of one-half of the Premiums being lodged with the Secretary on or before the 1st December next.

4. PLOUGHING COMPETITIONS.

The Silver Medal will be given to the Winner of the first Premium at Ploughing Competitions, where there are fifteen Ploughs, and Premiums to the amount of Three Sovereigns are awarded. To authorise the issue of the Medal, a Report, in the following terms, must be made to the Secretary, within three months of the date of the Competition, by a Member of the Society who was present.

I   of   Member of the Highland and Agricultural Society, hereby certify, that I attended a Ploughing competition at   on the   when   ploughs competed;   of land was assigned to each, and   hours were allowed for the execution of the work. The sum of £   was awarded in the following proportions, viz.:

[Here enumerate the names and designations of successful competitors.]

A Ploughman is to receive no assistance, and his work is in no respect to be touched by others.

In estimating the work of Competitors, attention should be directed to its sufficiency below, as well as to its neatness above, the surface.

On land of average tenacity, the rate of ploughing should be not less than will turn over an imperial acre in ten hours.

A Ploughman can not carry more than one Medal in the same year.

MEDALS IN AID OF PREMIUMS GIVEN BY LOCAL SOCIETIES.

The Society being anxious to co-operate with Local Associations in their efforts to promote improvement, will give a limited number of Medals annually, in addition to the Money Premiums which may be awarded to Tenants by such Associations—

1. For the best managed Farm.

Applied for by the Nairnshire Farming Society.—Convener, James Campbell Brodie, Esq. of Lethen.

By the District of Ballindalloch.—Convener, Thomas Macpherson Grant, Esq.

By the Inverness Farmers' Society.—Convener, Arthur Forbes, Esq. of Culloden.

By the Carrick Farmers' Society.—Convener, P. W. Kennedy, Esq. of Drumellan.

2. For the best managed Dairy.

Applied for by the Bute Farmers' Society.—Convener, Thos. Gibson, Esq. of Spittal, M.D.

3. For the best managed Green Crop.

Applied for by the Ythanside Farmers' Club.—Convener, Charles Napier Gordon, Esq. of Esslemont.

By the Bute Farmers' Society.—Convener, Thomas Gibson, Esq. of Spittal, M.D.

By the Lower Annandale Agricultural Society.—Convener, Colonel Graham of Mossknow.

By the Inverness Farmers' Society.—Convener, Arthur Forbes, Esq. of Culloden.

By the District of Breadalbane.—Convener, The Marquis of Breadalbane.

By the Dalrymple Farmers' Society.—Convener, James Campbell, Esq. of Craigie.

4. For the best kept Fences. *No application.*

5. For the best kept Dunghill.

Applied for by the District of Breadalbane.—Convener, The Marquis of Breadalbane.

6. For the greatest extent of Land, in proportion to the size of the Farm, subsoiled or trench ploughed. *No application.*

7. To the Labourer most expert and efficient in opening and filling Drains, and otherwise executing the works necessary in thorough Draining.

Applied for by the Nairnshire Farming Society.—Convener, James Campbell Brodie, Esq. of Lethen.

By the Carrick Farmers' Society.—Convener, P. W. Kennedy, Esq. of Drumellan.

8. To the Labourer most expert in Cutting Hedges.

Applied for by the East of Berwickshire Farmers' Club.—Convener, David Milne Home, Esq. of Wedderburn.

The Medals to be issued will be limited to ten in each class. Reports of the several Competitions must be lodged by the 15th of October, and applications for 1854 must be lodged by 1st November next, accompanied with a guarantee, that, in addition to the Medal, Premiums of not less than £3 will be given by the District applying.

CLASS V.

COTTAGES AND GARDENS.

The following Premiums are offered for competition in the Parishes aftermentioned. The Medals and one-half of the Premiums are given by the Society, and the other half is contributed by the respective Parishes.

1. COTTAGES.

1. For the best kept Cottage in each Parish—One Pound Five Shillings; and where there are four Competitors—The Silver Medal.
2. For the second best—One Pound.
3. For the third best—Fifteen Shillings.

2. GARDENS.

1. For the best kept Cottage Garden in each Parish—One Pound

Five Shillings; and where there are four Competitors—The Silver Medal.

2. For the second best—One Pound.

3. For the third best—Fifteen Shillings.

PARISHES.

County of Aberdeen.

ELLON.—Convener, Charles Napier Gordon, Esq. of Eslemont.

County of Ayr.

DALRYMPLE.—Convener, John Cogan, Esq., Cassilis House.

County of Dumbarton.

BONHILL.—Convener, Alexander Smollett, Esq. of Bonhill, M.P.

County of Forfar.

CRAIG.—Convener, William M. Macdonald, Esq. of St Martins.

County of Lanark.

CULTER.—Convener, William Handyside, Esq. of Cornhill.

LAMINGTON.—Convener, A. D. R. Cochrane Wisheart Baillie, Esq. of Lamington; in his absence, Rob. Paterson, Esq. of Birthwood.

County of Perth.

MOULIN.—Convener, Archibald Butter, Esq. of Faskally.

REDGORTON.—Convener, Robert Graham, Esq. of Redgorton.

County of Roxburgh.

YETHOLM.—Convener, Adam Brack Boyd, Esq. of Cherrytrees.

County of Stirling.

KILLEARN.—Convener, John Buchanan, Esq. of Carbeth.

CONDITIONS.

1. Competitions may take place in the different Parishes for Cottages and Gardens, or for either separately.

2. In either case, the occupiers of Gentlemen's Lodges and Gardeners' Houses are excluded, as well as Gentlemen's Servants occupying Cottages in the policies, or on land in the natural possession of their masters. The inspection must be completed by the 1st of October. In making the inspection, the Conveners may take the assistance of any competent judge.

3. The annual value of each Cottage, with the ground occupied in the parish by a Competitor, shall not exceed £5 sterling; and there must at least be three Competitors in each District. A Cottage or Garden which has gained a Premium in a previous year, cannot compete again for the same or a lower Premium.

4. If the Cottage is occupied by the proprietor, the roof must be in good repair; if the roof is of thatch, it must be in good repair, though in the occupation of a tenant. The interior, and the external conveniences must be clean and orderly,—the windows must be free of broken glass, clean, and affording the means of ventilation. Dunghills, and all other nuisances, must be removed from the front and gables. In awarding the Cottages Premiums, preference will be given to Competitors, who, in addition to these requisites, have displayed the greatest taste in ornamenting the exterior of their houses, and the ground in front and at the gables. In the event of there not being three Competitors, it will be in the power of the Committee to award one-half of the Premium, if the merits of the Cottage or Garden shall appear to be such as to deserve it.

5. In estimating the claims for the Garden Premium, the Judges should have in view—the sufficiency and neatness of the fences; the cleanness of the ground, and neatness of the walks; the quality of the crops, and general productiveness of the garden; and the choice of crops.

6. Reports, stating the number of Competitors, the names of successful parties, and the nature of the exertions which have been made by them, must be transmitted by the Conveners to the Secretary of the Society, on or before the 15th of October next.

Parishes desirous of these Premiums must lodge applications with the Secretary on or before the 1st November next.

1. MEDALS FOR COTTAGES OR GARDENS.

The Society will issue annually twelve Medals to Local Associations, or individuals, who, at their own expense, establish Premiums for Cottages or Gardens.

The Medals will be issued upon a Report by a Member of the Society, in the terms required by the preceding conditions, describing the merits of the Cottages or Gardens. The same individual shall not receive more than Two Medals in five years. The Reports to be lodged with the Secretary on or before the 15th of October 1853.

2. IMPROVING EXISTING COTTAGES.

To the Proprietor in Scotland who shall Report the Improvement of the greatest number of Cottages in the years 1850, 1851, and 1852—The Gold Medal.

3. BUILDING NEW COTTAGES.

To the Proprietor in Scotland who shall report the erection of

the greatest number of approved Cottages during the years 1849, 1850, 1851, and 1852—The Gold Medal.

CONDITIONS.

Claims for the above Premiums must be lodged with the Secretary on or before the 1st of October next, to allow an inspection to be made of the different Cottages. The inspections will be conducted by Committees of the Society's Members in the different Districts; and Reports must be transmitted by the Conveners to the Secretary on or before the 1st December.

The annual value of the Cottage or Cottages separately, with garden ground, must not exceed £5.

In estimating the claims of Competitors, the following points will be kept in view—the external appearance of the Cottages, their internal accommodation; the arrangements of the outhouses; the means of drainage and ventilation; and the expense of the building or of the alteration compared with its durability and accommodation. When the Cottages of one Competitor are superior in style and comfort to those of another, though not so numerous, the Inspectors to give them the preference, provided they amount at least to three, and have been erected at a moderate expense.

Parties competing to forward plans, specifications, and estimates, to the Society, of which, and of all information sent therewith, copies may be taken for publication, if the Society shall see fit, and the originals returned to the parties within six months, if desired.

4. ACCOMMODATION FOR FARM-SERVANTS.

To the Proprietor in Scotland who shall have erected on his estate, the most approved Farm-buildings in reference to the proper accommodation of Farm-Servants—The Gold Medal.

Reports, Plans, and Specifications, to be lodged by the 1st of November 1853.

AGRICULTURAL MEETING

AND

GENERAL SHOW OF STOCK AND IMPLEMENTS, AT BERWICK-UPON-TWEED, 1854.

The Society will hold an AGRICULTURAL MEETING and GENERAL SHOW of Breeding Stock and of Implements at Berwick-upon-Tweed, in 1854. The List of Implements, and the amount of the different Premiums, will be afterwards intimated. In the meantime, for the information of Breeders, the following Classes

of Stock are published, in each of which Money Premiums will be offered for the first and second best, and Tickets of Commendation for the third.

CATTLE.

CHALLENGE CUP.

The Secretary will receive Subscriptions for a CHALLENGE CUP, to be given to the Best Animal, of any age or breed, in the Class of Cattle, and to be won at three successive Shows by the same person before becoming his property. The Subscription will be closed on 1st January 1854, and the amount subscribed must be £100, towards which the Society will contribute £20.

SHORT-HORN BREED.

Bulls calved before 1st January 1852.
Bulls calved after 1st January 1852.
Bulls calved after 1st January 1853.
Bull Calves, calved after 1st January 1854.
Cows of any age.
Heifers calved after 1st January 1852.
Heifers calved after 1st January 1853.
Heifer Calves, calved after 1st January 1854.

POLLED BREEDS.

Bulls calved before 1st January 1852.
Bulls calved after 1st January 1852.
Cows of any age.
Heifers calved after 1st January 1852.

AYRSHIRE BREED.

Bulls of any age.
Cows of any age, in milk.
Cows of any age, in calf.
Heifers calved after 1st January 1852.

HIGHLAND BREED.

Bulls of any age.
Cows of any age.
Heifers calved after 1st January 1851.

HORSES,

FOR AGRICULTURAL PURPOSES.

Stallions.
Entire Colts foaled after 1st January 1851.
Entire Colts foaled after 1st January 1852.
Entire Colts foaled after 1st January 1853.
Mares.
Fillies foaled after 1st January 1851.
Fillies foaled after 1st January 1852.
Fillies foaled after 1st January 1853.

SHEEP.

LEICESTER BREED.

Tups, not more than four shear.
Dinmont or Shearling Tups.
Ewes, in pens of five, not more than four shear.
Shearling Ewes or Gimmers, in pens of five.

CHEVIOT BREED.

Tups, not more than four shear.
Dinmont or Shearling Tups.
Ewes, in pens of five, not more than four shear.
Shearling Ewes or Gimmers, in pens of five.

BLACKFACED BREED.

Tups, not more than four shear.
Dinmont or Shearling Tups.
Ewes, in pens of five, not more than four shear.
Shearling Ewes or Gimmers, in pens of five.

SOUTHDOWN BREED.

Tups, not more than four shear.
Dinmont or Shearling Tups.
Ewes, in pens of five, not more than four shear.
Shearling Ewes or Gimmers, in pens of five.

SWINE.

Boars, large Breed.
Boars, small Breed.
Sows, large Breed.
Sows, small Breed.
Pigs, in pens of three, not exceeding eight months old.

IMPLEMENTS.

The Manufacturers of Agricultural Implements and Machinery are informed, that a liberal Sum will be set aside for their Competition, and that a List of the Articles, for which Premiums are to be offered, will be published in due time to admit of preparation.

VETERINARY COLLEGE.

This Establishment is conducted under the superintendence of Professor Dick, Veterinary Surgeon, the Society's Lecturer. The curriculum of study embraces the principles and practice of Medicine and Surgery applied to domesticated Animals; Anatomy and Demonstrations; Pharmacy; Chemistry; and Materia Medica.

Students have the advantage of assisting in an extensive practice, and of performing the different operations which most frequently occur.

Attendance at Two Courses is required before a Student is taken upon trial for diploma; and the Graduates of the College are eligible for appointments as Veterinary Surgeons in Her Majesty's Service, and that of the East India Company.

MUSEUM.

The Museum, George IV. Bridge, is open from eleven till three o'clock every day except Monday. The public are admitted on inscribing their names in the Visiters' Book. Persons desirous of preserving Models of Agricultural Implements or Machines, or Vegetable or Mineral Specimens, are invited to transmit them to the Conservator of the Museum, by whom they will be included in the Collections, if approved of by the Directors.

MONTHLY MEETINGS.

Periodical Meetings are held in the Museum, when papers are read, and subjects in the science and practice of Agriculture are discussed. Strangers are admitted to the Meetings on application to the Secretary, but only Members can take part in the business.

LABORATORY.

Dr Anderson, the Society's Chemist, will receive communications on all subjects connected with the Chemical Department, at the Laboratory, 15 Shuttle Street, Glasgow.

The following are the rates at which analyses, &c., are furnished to *Members of the Society* :—

1. Complete analysis of a Soil, including determination of alkalies and phosphates, £3.
2. A partial analysis of a Soil, such as the determination of the quantity of organic matter, and relative proportion of clay, sand, and carbonate of lime it contains, 10s.
3. Quantitative determination of any one ingredient of a Soil, 7s. 6d.
4. Complete analysis of Saline Manures and other substances, such as Gypsum, Nitrates of Soda and Potash, Ammoniacal Salts, Guano, Oil-Cake, Bone-Dust, Rape-Dust, Superphosphate of Lime, £1.
5. Testing any of the above substances for adulterations,—for each sample, 5s.

   This examination is sufficient to determine whether or not any of these substances are grossly adulterated, but it gives no idea of the comparative value of different Samples where all are genuine.

6. Complete analysis of limestones, marls, shell-sands, etc., £1.
7. Examining any of the above substances for the quantity of lime, and ascertaining in the same the presence of Magnesia and Alumina, 7s. 6d.

   Ascertaining the proportion of these, 2s. 6d. additional for each substance.

8. Complete Analysis of the Ashes of any Plant, £3.

9. Complete analysis of a water, £2.
10. Determination of the amount of Salts in solution, and of the lime thrown down by boiling in any water, 10s.
11. Analysis of Tile or Fire-Clay, £1, 10s.
12. Examining products of Vegetation, or of the Dairy, such as nutritive matters in Wheat, or other grain,—quantity of butter or cheese in milk, 5s. for each ingredient.
13. Answers to Letters asking advice on subjects within the department of the Chemist, 5s.

The charges for other analyses not specified in this list, will be settled by the Committee of Management, with reference to the amount of work which they involve, and on a scale similar to the above.

INSTRUCTIONS FOR SELECTING SAMPLES FOR ANALYSIS.

Much inconvenience and delay having been experienced by persons sending samples for Analysis which had not been sufficiently carefully selected, and were afterwards found not to represent the average composition of the substance, it is particularly requested that the following instructions may be attended to as closely as circumstances will permit.

Manures.—A large handful of the manure should be taken from each of *at least* five or six different parts of the cargo, and if any lumps are found in it, a due proportion of these should also be taken. The whole being laid on a large sheet of paper, should be carefully mixed by rubbing with the hand, the lumps being broken down, and mixed as uniformly as possible with the powdery part. If this mixture be carefully made, a quantity of it not exceeding *three ounces*, will suffice for the analysis. It should be folded up in tinfoil to prevent its becoming dry, and is most cheaply and expeditiously forwarded by post. In default of tinfoil, the sample may be wrapped in double folds of strong writing paper, and if the paper be well rubbed with wax, so as to make it impervious to moisture, it will answer nearly as well. Should the manure contain stones, or be very moist, or should any difficulty be experienced in making a uniform mixture, it is desirable that *two or three pounds* should be sent.

Soils.—In selecting Soils for Analysis, five or six spadefuls should be taken from different parts of the field, and, after being spread out in a thin layer for several days to dry, it should be put two or three times through a fine sieve, so as to insure uniform mixture. For a complete analysis, not less than *four pounds* should be sent; for a partial analysis, three or four ounces will be sufficient.

Waters.—For the complete analysis of a water, about *two gallons* are required; for the determination of the amount of salts in solution, and lime thrown down by boiling, *a quart* will suffice. A well water may be selected at any time, but the water of a spring or running stream should be taken in dry weather. The jars or bottles in which they are sent must be tightly corked and sealed. In the analysis of a mineral water, it may sometimes be desirable to determine the amount of gases held in solution, in which case certain precautions must be observed which require the presence of a Chemist at the spring.

Limestones, Clays, Ironstones, &c.—If the bed of any of these substances of which the analysis is required be very uniform in appearance, a piece of two or three ounces weight, taken from any part of it, will be enough for analysis; but, in all cases, it is better to send three or four chips from different parts of its thickness. Sometimes, where the characters of different parts of the bed vary much, separate analyses of these portions may be requisite, in which case two ounces of each may be sent.

Every sample sent for analysis should be distinctly labelled, and marked with the name and address of the sender in full, and, in the case of imported manures, the name of the ship should, if possible, be mentioned. All samples should be accompanied by a letter, specifying the nature of the information required, and, if possible, the object in view, as, by doing so, much trouble and delay will occasionally be saved.

By Order of the Directors.

J[N.] HALL MAXWELL, *Secretary.*

EDINBURGH, 6 ALBYN PLACE,
10*th February* 1853.

LIST OF MEMBERS

OF

THE HIGHLAND AND AGRICULTURAL SOCIETY OF SCOTLAND,

AT 1st MARCH 1853.

ALPHABETICALLY ARRANGED, AND DISTINGUISHING THE YEAR OF ADMISSION.

President.

THE DUKE OF HAMILTON AND BRANDON.

The Members marked *, have been Presidents; and † Vice-Presidents.

New Members are admitted at the General Meetings of the Society by Ballot. There are two such Meetings annually, viz., the Annual Meeting, on the second Tuesday of January, and the Summer General Meeting, on such day in June or July as may be fixed by the Directors, and intimated in terms of the Charter. The ordinary Subscription is £1, 3s. 6d. annually, which may be redeemed by one payment, varying from £12, 12s. to £7, 1s. Tenant Farmers, Members of any Local Association, are admitted on a Subscription of 10s. annually, or £5, 5s., for Life.

EDINBURGH:
PRINTED BY NEILL AND COMPANY.

MDCCCLIII.

LIST OF MEMBERS.

	Admitted
ALBERT, His Royal Highness the Prince, K.G., Honorary Member	1841
ARGYLL, His Grace George, Duke of	1844
ATHOLE, His Grace George Augustus Frederick John, Duke of	1834
ATHOLE, Her Grace Ann, Duchess of	1841
†AILSA, The Most Noble Archibald, Marquis of	1847
ABERCORN, The Most Noble James, Marquis of, K.G.	1833
AIRLIE, The Right Hon. David Graham Drummond, Earl of	1852
†ABERDEEN, The Right Hon. George, Earl of, K.T.	1805
ABOYNE, The Right Hon. Charles, Earl of	1819
10 †ARBUTHNOTT, The Right Hon. John, Viscount	1803
ABINGER, The Right Hon. R. C., Lord	1841
ABERDOUR, The Right Hon. Sholto John, Lord	1846
ANDERSON, The Hon. Lord	1834
ARBUTHNOTT, Lieut.-General the Hon. Hugh, M.P. for Kincardineshire	1811
ARBUTHNOTT, The Hon. John	1833
AGNEW, Sir Andrew, of Lochnaw, Bart.	1850
ABERCROMBY, Sir Robt., of Birkenbog & Forglen, Bart.	1816
ABERCROMBY, Lady, of Birkenbog and Netherlaw	1840
ANSTRUTHER, Sir Windham Carmichael, of Anstruther and Carmichael, Bart.	1842
20 ANSTRUTHER, Sir Ralph Abercrombie, of Balcaskie and Watten, Bart.	1832
ANTROBUS, Sir Edmund, of Rutherford, Bart.	1829
ARBUTHNOTT, Sir Robert Keith, Bart.	1852
ALISON, Sir Archibald, Bart., Sheriff of Lanarkshire	1838
ADAM, Admiral Sir Charles, of Blair-Adam, K.C.B.	1829
ALEXANDER, Sir James Edward	1831

		Admitted
	ANDERSON, Sir James, M.P., Glasgow	1843
	ANGRAND, The Chevalier	1839
	Abercromby, Alexander, Glasgow	1844
	Abercromby, Arthur, of Glassaugh	1832
30	Abercromby, George S., younger of Birkenbog	1850
	Adair, John, of Genoch	1829
	Adam, James, S.S.C.	1842
	Adam, James Graham, Denovan Field, Denny	1839
	Adam, Robert Parker, of Tour	1849
	Adam, William, of Ranna, Advocate, Aberdeen	1839
	Adam, William Patrick, yr. of Blair-Adam	1853
	Adamson, James, Morphie, Montrose	1850
	Addie, Robert, of Viewpark	1844
	Agnew, Robert Vans, of Sheuchan and Barnbarroch	1843
40	Ainslie, John, Pentland, Loanhead	1848
	Ainslie, Philip B.	1826
	Ainslie, Robert, W.S.	1847
	Ainslie, Robert, of Elvingston	1853
	Aitchison, Francis, Edinburgh	1831
	Aitchison, James, of Alderston	1822
	Aitchison, James, Proneynain, Dornoch	1851
	Aitchison, John, Brewer, Edinburgh	1852
	Aitchison, Lieut.-General John, London	1852
	Aitchison, William, Linhope, Hawick	1835
50	Aitken, James, of Gartcows	1834
	Aiton, Rev. John, D.D., Minister of Dolphinton	1828
	Alcock, Robert	1833
	Alexander, Alexander Humphreys	1825
	Alexander, Boyd, of Southbar	1823
	Alexander, James, of Balmule	1842
	Alexander, James, Firbank, Lasswade	1848
	Alexander, William Maxwell, of Ballochmyle	1823
	Alison, Alexander, Glasgow	1844
	Alison, Robert, Dundee	1843
60	Allan, Alexander, Advocate	1833
	Allan, Lieut.-Colonel, Edinburgh	1847
	Allan, James, Clifton Mains, Kirkliston	1851
	Allan, James, West Mains, Stonehouse	1852
	Allan, Thomas William Murray, of Havering, Essex	1852
	Allan, William, Edinburgh	1830
	Allan, William, Winchburgh	1852
	Allardice, Robert Barclay, of Ury	1810
	Allen, James, Merchant, Glasgow	1815
	Alston, James W., of Stockbriggs	1844
70	Alston, John Patrick, of Muirburn	1850

		Admitted
	Anderson, Alexander, Advocate, Aberdeen	1838
	Anderson, A. D., M.D., Glasgow	1844
	Anderson, Major Alexander, of Montrave	1833
	Anderson, David, of Moredun	1825
	Anderson, David, of St Germains	1829
	Anderson, David, Westhaven, Dundee	1843
	Anderson, David, Blackdykes, North Berwick	1852
	Anderson, Francis, W.S.	1841
	Anderson, George, Solicitor, Inverness	1839
80	Anderson, George, Glasgow	1844
	Anderson, James, Laggan, Ballantrae	1838
	Anderson, James A., of Carlung	1838
	Anderson, John, Lewinshope, Selkirk	1852
	Anderson, John, Merchant, London	1838
	Anderson, John, Merchant, Glasgow	1838
	Anderson, John, Factor for Lord Lovat, Strichen	1840
	Anderson, Lawrence, Chapel, Moffat	1851
	Anderson, Michael, Edinburgh	1831
	Anderson, Robert Hood, Glasgow	1850
90	Anderson, Stephen, of Carfin	1849
	Anderson, Thomas, of Glendrisaig, Advocate, Sheriff-Substitute, Kilmarnock	1832
	Anderson, Thomas, M.D., Professor of Chemistry, University of Glasgow, Chemist to the Society	1849
	Anderson, William, Town-Clerk of Leith	1842
	Anderson, William James, Edinburgh	1840
	Angus, Ritchie, Glasgow	1844
	Anstruther, James, Moray Place, Edinburgh	1827
	Anstruther, Philip, of Tillicoultry	1846
	Arbuthnot, George Clerk, of Mavisbank	1844
	Arbuthnot, Robert, Junior, Culter Mills, Aberdeen	1852
100	Arbuthnot, Thomas, of Meethill	1829
	Arbuthnott, James Carnegy, of Balnamoon	1813
	Archer, Andrew, Abbey Hill, Coupar Angus	1846
	Archibald, John, Duddingston, South Queensferry	1849
	Arklay, John, Powmill, Brechin	1853
	Arkley, Patrick, of Duninald, Advocate	1840
	Arkley, Robert H., Mains of Duninald, Montrose	1850
	Armstrong, Chas., of Cherry Valley, County of Antrim	1836
	Arnott, G. A. Walker, of Arlary, LL.D., Professor of Botany, University of Glasgow	1837
	Arnott, James, of Leithfield, W.S.	1835
110	Ashby, Shukbrugh, Edinburgh	1843
	Askew, Henry William, of Minard	1845
	Auchterlonie, Thomas, Merchant, Glasgow	1850

Admitted

Austin, R. Speir, Middleton, Muthill 1851
Aytoun, James, Advocate, Edinburgh 1849
Aytoun, Roger, of Inchdairnie 1844
Aytoun, William Edmonstoune, Advocate, Sheriff of Orkney and Shetland 1838

Buckingham and Chandos, His Grace Richard Plantagenet, Duke of, K.G., Honorary Member 1837
*Buccleuch and Queensberry, His Grace Walter Francis, Duke of, K.G. 1828
Buccleuch and Queensberry, Her Grace Charlotte, Duchess of 1835
120 †Breadalbane, The Most Noble John, Marquis of 1819
Breadalbane, The Most Noble Elizabeth, Marchioness of 1838
Buchan, The Right Hon. Henry David, Earl of 1811
Blantyre, The Right Hon. Charles, Lord 1843
Belhaven and Stenton, The Right Hon. Robert, Lord 1816
Berriedale, The Right Hon. James, Lord 1845
Bruce, The Hon. Thomas Charles 1852
Burnett, Sir Alexander, of Leys, Bart. 1834
Bruce, Sir Michael, of Scotstoun and Stenhouse, Bart. 1825
Baird, Sir James Gardner, of Saughtonhall, Bart. 1843
130 Blair, Sir David Hunter, of Brownhill, Bart. 1801
Baillie, Sir William, of Polkemmet, Bart. 1818
Boswell, Sir James, of Auchinleck, Bart. 1834
Boswall, Sir George Houstoun, of Blackadder, Bart. 1848
Brisbane, General Sir Thomas Makdougall, of Brisbane and Makerstoun, Bt., G.C.B. and G.C.H. 1801
Ballingall, Sir George, M.D., Professor of Military Surgery, University of Edinburgh 1821
Bannerman, Sir Alex., Lieut.-Governor of Prince Edward Island 1835
Bagot, Richard W., Honorary Secretary, Fontstown Agricultural Society, Kildare, Ireland 1852
Baikie, James, of Tankerness 1818
Baillie, A. D. R. Cochrane Wisheart, of Lamington 1842
140 Baillie, Charles, Advocate, Sheriff of Stirlingshire 1831
Baillie, Evan, of Dochfour 1824
Baillie, George, of Jerviswoode 1841
Baillie, Henry James, younger of Redcastle, M.P. 1839
Baillie, Colonel Hugh Duncan, of Redcastle, 1839
Baillie, James Evan, of Glenelg and Kingussie 1839
Baillie, James William, younger of Culterallers, W.S. 1851

		Admitted
	Baillie, Robert Granbery, of Culterallers	1819
	Baillie, William, younger of Polkemmet	1847
	Baillie, William R., W.S.	1848
150	Bain, John, of Morriston	1833
	Baird, Alexander, of Faskine and Palace Craig	1845
	Baird, Charles J.	1844
	Baird, David, Gartsherrie	1850
	Baird, Douglas, of Closeburn	1838
	Baird, George, Gartsherrie	1838
	Baird, James, Gartsherrie, M.P.	1838
	Baird, John, Highcross	1838
	Baird, John, George Street, Edinburgh	1850
	Baird, Robert, Gartsherrie	1838
160	Baird, William, of Gartsherrie	1844
	Baird, William, Grain-Merchant, Glasgow	1844
	Bald, Robert, Civil Engineer, Edinburgh	1828
	Balfour, Charles, of Balgonie	1846
	Balfour, David, of Trenabie	1843
	Balfour, Francis, of Fernie	1824
	Balfour, James, of Pilrig, W.S.	1824
	Balfour, James M., of Whittingham	1846
	Balfour, James, Milton, Leuchars	1842
	Balfour, John, of Balbirnie	1839
170	Balfour, John Hutton, M.D., Professor of Botany, University of Edinburgh	1839
	Balfour, Lieut.-Colonel, of Arbigland	1849
	Balfour, William, of Gairsay	1844
	Balfour, William, Merchant, Glasgow	1820
	Ballantyne, James, of Castlehill	1822
	Ballantyne, James, of Holylee	1832
	Ballantyne, John, Braid, Edinburgh	1848
	Ballantyne, Thomas, Whitehope, Selkirk	1852
	Ballingal, Neil, Seggie, Kinross	1851
	Bannatyne, Dugald John, of Eastbank	1851
180	Bannerman, Patrick, Advocate, Aberdeen	1825
	Barbour, Thomas, of Dalshangan	1846
	Barclay, Arthur Hay, of Paris	1848
	Barclay, George Robertson, of Keavil	1834
	Barclay, Major P., Edinburgh	1847
	Barker, Thomas, of Sydney, Australia	1839
	Barlas, Robert, Edinburgh	1844
	Barns, Patrick Graham, of Limekilns	1836
	Barr, James, Factor, Springkell, Ecclefechan	1847
	Barr, John, Barangry, Bishopton	1851
190	Barstow, Charles M., Edinburgh	1846

		Admitted
	Bartholomew, John, of Broomhill, Merchant, Glasgow	1838
	Bartholomew, Robert, Merchant, Glasgow	1838
	Baxter, David, Dundee	1843
	Baxter, John G., Ellengowan, Dundee	1843
	Baxter, William G., Ellengowan, Dundee	1843
	Bayley, Isaac, of Manuel, Edinburgh	1828
	Begbie, Alexander, Leamington	1832
	Begbie, Thomas, Queenston-bank, Drem	1852
	Beith, Hector, High Lossit, Campbeltown	1849
200	Beith, John, Banker, Campbeltown	1836
	Belches, Alexander Hepburn Murray, of Invermay	1824
	Belches, Lieut.-Colonel John H. Murray, Invermay	1825
	Belford, Andrew, of Glenfintaig, Solicitor, Inverness	1839
	Belfrage, George, North Gyle, Corstorphine	1849
	Belfrage, James, Samuelston East Mains, Haddington	1849
	Bell, Allan, of Hillowton, Castle-Douglas	1839
	Bell, Archibald, Advocate, Sheriff of Ayrshire	1833
	Bell, George, Merchant, Leith	1826
	Bell, George, Inchmichael, Errol	1852
210	Bell, George, of Menslaws	1842
	Bell, George Graham, of Crurie, Advocate	1835
	Bell, George Hamilton, Surgeon, Edinburgh	1848
	Bell, John, of Enterkine	1839
	Bell, John Beatson, of Glenfarg, W.S.	1841
	Bell, John Montgomery, Sheriff of Kincardineshire	1852
	Bell, Robert, Advocate, Sheriff of Berwickshire	1823
	Bell, Robert, of Lunna, Sheriff-Substitute of Shetland	1846
	Bell, Robert, Architect and Landsurveyor, Edinburgh	1851
	Bell, William, of Gribdae	1840
220	Bence, Henry A., Thorington Hall, Suffolk	1850
	Benton, R. E. C., Glasgow	1852
	Berry, John, of Tayfield, Advocate	1848
	Bertram, Thomas Hardy, Engineer, Reading, Berks	1845
	Bertram, William, of Nisbet	1852
	Berwick, Alexander, of Nortonhall	1839
	Berwick, Alexander, junior, Brewer, Edinburgh	1852
	Bethune, Alexander, of Blebo	1848
	Beveridge, James, Easter Balado, Secretary, Kinross Agricultural Society	1851
	Beveridge, Robert E., Urquhart, Dunfermline	1853
230	Beveridge, Thomas, Depute-Clerk of Session	1816
	Beveridge, Thomas Knox, W.S.	1833
	Bigg, Thomas, London	1842
	Binnie, John, West Craigs, Corstorphine	1847
	Binnie, Robert, Seton Mains, Tranent	1847

		Admitted
	Binning, John, Factor, Tulloch, Dingwall	1849
	Biscoe, Thomas Porter Bonell, of Newton, Inverness	1846
	Black, Adam, Edinburgh	1846
	Black, David, Barrelwell, Brechin	1850
	Black, James, Factor, Ellon, Aberdeenshire	1851
240	Black, James, Merchant, Glasgow	1838
	Black, James, Knock, Grange, Banffshire	1852
	Black, James, Stronardran, Cairndow	1853
	Black, James Spens, Merchant, Glasgow	1839
	Black, John, Writer, Wigtown	1847
	Black, John, Aralry, Kinross	1851
	Black, John Young, of Clayton	1850
	Black, Robert, Glasgow	1844
	Blackburn, Peter, of Killearn	1842
	Blackburn, Robert B., Advocate	1846
250	Blackwood, John, Publisher, Edinburgh	1842
	Blackwood, Captain William, Edinburgh	1851
	Blaikie, John, of Craigiebuckler, Advocate, Aberdeen	1837
	Blaikie, Thomas, Aberdeen	1840
	Blair, Colonel Stopford, of Penninghame	1849
	Blair, Lieut.-Colonel James Hunter, yr. of Blairquhan, M.P.	1852
	Blair, David Anderson, Advocate	1819
	Blair, Edward Hunter, of Dunskey	1850
	Blair, Captain William Fordyce, of Blair, R.N.	1844
	Blair, William, of Avonton	1817
260	Blanchard, George, Merchant, Edinburgh	1847
	Blandow, Michael Von, St Petersburgh, Hon. Mem.	1836
	Blane, Robert, of Grougar	1836
	Blood, Bindon, of Cranaker, Ireland	1833
	Boag, James, Merchant, Edinburgh	1842
	Bogie, James, of Kinloch	1848
	Bogie, John, Balcanquhall, Auchtermuchty	1851
	Bogle, James, Merchant, Glasgow	1844
	Bonar, Andrew, Banker, Edinburgh	1824
	Bonar, James	1835
270	Bonar, William, Edinburgh	1828
	Bonar, William Graham, of Greigston	1835
	Boog, William, Factor to Sir James Colquhoun, of Luss, Bart.	1841
	Booth, James Godfrey, Seed-Merchant, Hamburg	1842
	Borthwick, John, of Crookston	1846
	Borthwick, Thomas Chalmers, Hopsprig, Langholm	1838
	Borthwick, Lieut.-Colonel William, Georgefield, Langholm	1843

		Admitted
	Boswell, John Douglas, of Garallan	1836
	Boswell, John Irvine, of Kingcaussie and Balmuto	1823
	Boulderson, Shadwell M.	1840
280	Bowie, John, W.S.	1815
	Bowhill, Thomas, Secretary, East of Berwickshire Farmers' Club, Ayton	1853
	Boyd, Adam Brack, of Cherrytrees	1841
	Boyd, John, of Broadmeadows	1804
	Boyle, Archibald Thomas, Advocate	1846
	Boyle, Patrick, of Shewalton	1835
	Boyle, Robert, Tile-Manufacturer, Ayr	1850
	Brand, William, Secretary, Union Bank of Scotland	1846
	Brander, Lieut.-Colonel James, of Pitgaveny	1827
	Brander, James, Banker, Golspie	1830
290	Brandreth, Humphrey, of Houghton House, Dunstaple	1840
	Brebner, James, Advocate, Aberdeen	1834
	Bremner, Charles, W.S.	1800
	Broadbent, John Harvey, Clayley Hall, Handley, Cheshire	1848
	Broadfoot, John, Merchant, Leith	1851
	Brock, Henry, Glasgow	1838
	Brock, John, Overton, Kirkliston	1851
	Brodie, James, Linplum, Haddington	1848
	Brodie, James Campbell, of Lethen	1831
	Brodie, John, Abbey Mains, Haddington	1840
300	Brodie, John Clerk, W.S.	1840
	Brodie, Peter, Clarilaw, Selkirk	1834
	Brodie, William, of Brodie	1821
	Broun, Charles Wilsone, of Wemyss	1852
	Brown, Andrew, M.D., Edinburgh	1852
	Brown, Alexander James Dennistoun, of Balloch	1844
	Brown, Andrew, of Auchintorlie	1844
	Brown, Major David, of Park	1834
	Brown, David Wardlaw, of Longformacus, Dunse	1841
	Brown, George, Wattin Mains, Wick	1839
310	Brown, George, Balgarvie, Cupar	1851
	Brown, Hugh, of Broadstone	1823
	Brown, Hugh H., of Newhall	1843
	* Brown, James, Accountant, Edinburgh	1816
	Brown, James, of Lochton, Dundee	1843
	Brown, James, Eskmill, Penicuik	1845
	Brown, James, Pentland Mains, Roslin	1846
	Brown, James, of Orchard	1849
	Brown, James Bertram, Smeaton, Dalkeith	1848

		Admitted
	Brown, Major J. D., Drylawhill, Prestonkirk	1821
320	Brown, James Thomas, younger of Auchlochlan	1837
	Brown, John George, Pinkie House, Musselburgh	1852
	Brown, Matthew, Greenock	1832
	Brown, Peter, Linkwood, Elgin	1821
	Brown, Robert, of Drumbrexhill, Hamilton	1802
	Brown, Robert, younger of Gilston	1845
	Brown, Thomas, of Lanfine and Waterhaughs	1832
	Brown, Thomas, Slipperfield, West Linton	1849
	Brown, William, Merchant, Glasgow	1828
	Brown, William, Banker, Maybole	1835
330	Brown, William, Merchant, Dundee	1843
	Brown, William, of Greenock Mains, Muirkirk	1850
	Brown, William Henry, of Ashley	1833
	Bruce, C. L. Cumming, of Roseisle and Kinnaird, M.P.	1817
	Bruce, James, Middleton, Mintlaw	1837
	Bruce, John, of Sumburgh, Zetland	1829
	Bruce, John, W.S.	1842
	Bruce, Onesephorus Tyndall, of Falkland	1829
	Bruce, Robert, of Kennet	1819
	Bruce, Thomas, of Arnot	1820
340	Bruce, William, of Symbister, Zetland	1838
	Bruce, William, Glasgow	1844
	Bryce, David, Architect, Edinburgh	1846
	Bryce, Rev. James, D.D.	1813
	Brydon, James, Moodlaw, Langholm	1850
	Bryson, Robert, Merchant, Glasgow	1850
	Bryson, W. G., Factor for the Earl of Seafield, Grantown	1852
	Buchan, George, of Kelloe	1826
	Buchan, William, Ratho Hall	1839
	Buchanan, Andrew, of Auchintorlie	1838
350	Buchanan, Andrew, of Mount Vernon	1827
	Buchanan, David Carrick, of Dumpellier	1849
	Buchanan, Duncan, Auchnabreck, Cairndow	1853
	Buchanan, George, of Arden	1838
	Buchanan, Isaac, Glasgow	1851
	Buchanan, James, Edinburgh	1820
	Buchanan, James, of Catrine	1838
	Buchanan, John, London	1838
	Buchanan, John, Finnich, Dumbarton	1831
	Buchanan, John, of Glenlora	1844
360	Buchanan, John, of Carbeth	1838
	Buchanan, Niel Giffiths, of Knockshinnoch	1850
	Buchanan, Robert, Glasgow	1811
	Buchanan, Rev. Thomas, Methven, Perth	1840

	Admitted
Buchanan, Thomas, of Wellshot, Glasgow	1849
Buchanan, Walter, of Shandon	1842
Buchanan, Walter W., M.D., Greenock	1844
Buchanan, William, Merchant, Glasgow	1828
Buist, James, Kirkton Barns, Newport	1842
Buist, Mathew, Factor, Tynninghame, Prestonkirk	1848
370 Burn, Henry J., of Cuttlehill, W.S.	1843
Burn, James, W.S.	1825
Burn, William, Architect, London	1824
Burnett, Alexander, Kinchyle, Factor for Lady Saltoun	1839
Burnett, George, Advocate	1848
Burnett, Gregory, Ardross	1840
Burnett, James Horn, W.S.	1834
Burnett, John Joseph, of Gadgirth	1836
Burnett, Newell, Advocate, Aberdeen	1834
Burnett, Thomas, Advocate, Aberdeen	1825
380 Burnley, W. F., Merchant, Glasgow	1838
Burt, Dr John, Edinburgh	1831
Burton, William Tait, of Toxside	1848
Butter, Archibald, of Faskally	1825
Buttery, A. W., Monkland Iron-Works, Airdrie	1844
Byres, William, Manager of the Scottish Midland Junction Railway	1852
Byres, Major-General Patrick, of Tonley	1843
Crawford and Balcarres, The Right Hon. James, Earl of	1847
Caithness, The Right Hon. Alexander, Earl of	1814
†Cathcart, Lieut.-Gen. Rt. Hon. Charles, Earl, K.C.B.	1809
390 †Cawdor, The Right Hon. John Frederick, Earl	1831
Colville (of Culross), The Right Hon. Charles John, Lord	1851
Campbell, The Right Hon. John, Lord	1834
Clerk, The Right Hon. Sir George, of Penicuik, Bart.	1812
Cuninghame, The Hon. Lord	1833
Cowan, The Hon. Lord	1848
Curriehill, The Hon. Lord	1822
Charteris, The Hon. Francis, M.P.	1847
Cathcart, Colonel The Hon. Frederick Macadam, of Craigengillan	1830
Colquhoun, Sir James, of Luss, Bart.	1829
400 Campbell, Sir James, of Aberuchil and Kilbride, Bart.	1838
Carmichael, Sir Thomas Gibson, of Castle Craig and Skerling, Bart.	1852

		Admitted
	CARNEGIE, Sir James, of Southesk, Bart.	1850
	CAMPBELL, Sir Hugh Hume, of Marchmont, Bart.	1834
	CATHCART, Sir John Andrew, of Carleton, Bart.	1834
	CUMMING, Sir William G. Gordon, of Altyre and Gordonston, Bart.	1808
	COLEBROOKE, Sir Thomas Edward, of Crawford, Bart.	1838
	CAMPBELL, Sir Archibald Islay, of Succoth, Bart., M.P.	1844
	CAMERON, Sir Duncan, of Fassfern, Bart.	1800
	CRAIG, Sir William Gibson, of Riccarton, Bart.	1824
410	CAMPBELL, Lieut.-Colonel Sir John, Bart.	1844
	CAMPBELL, Sir Alexander, of Barcaldine, Bart.	1845
	CAMPBELL, Sir Angus, of Dustaffnage, Bart.	1851
	CAMPBELL, Sir James, of Stracathro, Glasgow,	1838
	COCHRANE, Vice-Admiral Sir Thomas, K.C.B.	1817
	CHALMERS, Major-General Sir William, of Glenericht	1822
	Cadell, Alex. Tod, Madras Army	1844
	Cadell, Lieut.-Colonel, George	1842
	Cadell, Hew Francis, of Cockenzie	1844
	Cadell, James John, of Grange	1848
420	Calder, Marcus, Factor for Mr Balfour of Trenaby	1846
	Calder, William, Cattle-Salesman, Edinburgh	1851
	Caldwell, Frederick, of Missinish	1841
	Callander, William Burn, of Preston Hall	1818
	Callender, Henry, Accountant, Edinburgh	1843
	Cameron, Alexander, Surinam	1819
	Cameron, Allan, Calligary, Broadford	1803
	Cameron, Donald, of Lochiel	1834
	Cameron, Hugh Innes, London	1835
	Cameron, Capt. James, Aberdour House, Fraserburgh	1850
430	Cameron, John, of Barcaldine	1849
	Cameron, John, Corrychoiley, Fort-William	1826
	Cameron, John, of Glenesk	1846
	Cameron, Peter, Edinburgh	1850
	Cameron, William, Millhill, Auchterarder	1852
	Campbell, Alexander, of Auchindarroch	1837
	Campbell, Captain Alexander, of Brackley	1806
	Campbell, Alexander, of Monzie	1833
	Campbell, Alexander, London	1804
	Campbell, Alexander, of Barnhill	1833
440	Campbell, Alexander, Edinburgh	1835
	Campbell, Archibald, of Catrinebank	1810
	Campbell, Archibald, of Glendaruel	1826
	Campbell, Archibald, Factor on the Estate of Menzies	1832
	Campbell, Archibald, of Blythswood	1840
	Campbell, Archibald, younger of Lerags, M.D.	1845

		Admitted
	Campbell, Archibald James, of Kilpatrick	1824
	Campbell, Arthur, of Condorat, W.S.	1816
	Campbell, Charles, late of Combie	1808
	Campbell, Charles, Banker, Glasgow	1838
450	Campbell, Charles William, Edinburgh	1840
	Campbell, Colin, of Colgrain	1829
	Campbell, Colin, younger of Colgrain	1847
	Campbell, Colin G., younger of Stonefield	1838
	Campbell, Rear-Admiral Donald, of Barbreck	1840
	Campbell, Donald, younger of Sonachan	1840
	Campbell, Donald, Factor to M'Lean of Coll	1846
	Campbell, Dugald M'Neill, of Kintarbet	1847
	Campbell, Farquhar, Ormsary	1839
	Campbell, George, Succoth	1833
460	Campbell, George James, of Treesbanks	1835
	Campbell, Henry Fletcher, of Boquham	1823
	Campbell, Humphrey Walter, Dumbarton	1838
	Campbell, James, of Craigie	1824
	Campbell, James, Edinburgh	1838
	Campbell, James, younger of Tillichewan	1847
	Campbell, James, Balbrogie, Coupar-Angus	1850
	Campbell, James Archibald, of Inverawe	1833
	Campbell, James A., younger of Stracathro	1849
	Campbell, James Walton, of Walton Park, Dumfries	1846
470	Campbell, John, of Possil	1848
	Campbell, John, of Stonefield	1808
	Campbell, John, late of Glensaddel	1817
	Campbell, John, of Blairhall	1819
	Campbell, John, of Southall	1821
	Campbell, John, of Otter	1827
	Campbell, John, of Strachur	1829
	Campbell, John, of Achalader	1846
	Campbell, John, of Kilberry	1842
	Campbell, Colonel John, of Blackhall	1803
480	Campbell, John, W.S.	1793
	Campbell, John Archibald, W.S.	1813
	Campbell, John Deans, of Curreath and Loeg	1835
	Campbell, Kenneth, of Ardow	1843
	Campbell, Lorne, Roseneath	1824
	Campbell, Mungo, Glasgow	1837
	Campbell, Mungo, jun., Glasgow	1824
	Campbell, Mungo Nutter, of Ballymore	1832
	Campbell, Ord Graham, Edinburgh	1838
	Campbell, Richard, of Achinbreck	1833
490	Campbell, Richard D., of Jura	1836

		Admitted
	Campbell, Robert, of Sonachan	1802
	Campbell, Robert, of Auchmannoch	1816
	Campbell, Major Robert Nutter, of Ormidale	1844
	Campbell, Rose	1809
	Campbell, Thomas, Edinburgh	1837
	Campbell, Major Walter, N.B. Staff, Glasgow	1836
	Campbell, Walter Frederick	1817
	Campbell, William, of Tillichewan Castle	1838
	Campbell, William, of Ormsary	1839
500	Campbell, William, of Ederline	1843
	Cannon, James, Shiel, Castle Douglas	1813
	Cantlie, Wm. Keithmore, Mortlach	1852
	Carfrae, Major-General John, of Bowerhouse	1842
	Carfrae, Thomas, Land-Surveyor, Edinburgh	1850
	Carlisle, William, of Houstonfield	1835
	Carlyle, Thomas Johnstone, of Waterbeck	1845
	Carmichael, Michael Thomson, of Eastend	1825
	Carnaby, Thomas, Clerk of Lieutenancy, Forfar	1831
	Carnegie, David, of Stronvar	1847
510	Carnegie, James, of Edrom-Newton, W.S.	1852
	Carnegie, John, of Redhall	1836
	Carnegie, William Fullarton Lindsay, of Boysack and Kinblethmont	1824
	Carnegy, John, Cardonald, Paisley	1850
	Carnegy, Thomas, of Craigo	1851
	Carruthers, Alexander, of Warmanbie	1826
	Carruthers, Walter, Kirkhill, Moffat	1852
	Carruthers, William Francis, of Dormont	1848
	Carstairs, Drysdale, Merchant, Liverpool	1838
	Carstairs, John, of Springfield	1841
520	Carter, Thomas, Scales, Richmond, Yorkshire	1852
	Cassels, Alexander, W.S.	1848
	Cassels, David	1824
	Cathcart, Elias, of Auchindrane	1819
	Cathcart, Taylor, of Carbiston and Pitcairly	1842
	Cay, John, Advocate, Sheriff of Linlithgowshire	1841
	Chalmer, Major, Larbert House, Stirling	1852
	Chalmers, Charles, of Monkshill	1824
	Chalmers, David of Westburn	1834
	Chalmers, John Inglis, Charleton House, Montrose	1844
530	Chalmers, Patrick, of Auldbar	1834
	Chambers, Robert, Edinburgh	1841
	Chancellor, John, of Shieldhill, Advocate	1849
	Charge, Thomas, of Barton	1833
	Cheape, Robert C., of Strathtyrum	1847

	Admitted
Cheyne, Henry, of Tangwick, W.S.	1838
Cheyne, James Auchinleck, of Kilmaron	1825
Chiene, George Tod, Edinburgh	1838
Chiene, Patrick, Edinburgh	1820
Chisholm, Duncan Macdonell, of Chisholm	1839
540 Chisholm, John, of Stirches	1839
Chisholm, Lachlan, of Lochans, Askernish, South Uist	1831
Chivas, Alexander, Banker, Aberdeen	1840
Chivas, George, Seedsman, Chester	1848
Chrisp, James	1838
Christal, Robert, of Inchyra	1852
Christie, Andrew, Adinston, Tranent	1850
Christie, Charles J., Westbank, Tranent	1850
Christie, Charles Maitland, of Durie	1841
Christie, James, Hillend, Clackmannan	1835
550 Christie, John, of Pitgorno	1843
Christie, John, Goldielea, Dumfries	1846
Christie, John, Corsiestone, Huntly	1847
Christie, Robert, Accountant, Edinburgh	1824
Christie, Robert Stark, of Teasses	1852
Christison, R., M.D., Professor of Materia Medica, University of Edinburgh	1848
Christopher, Robert Adam, M.P.	1825
Chrystie, Captain Alexander, H.E.I.C.S.	1834
Chrystie, Captain Thomas, R.N.	1841
Church, James, junior, Tower of Sark, Canonbie	1838
560 Clapperton, Thomas, of Spylaw, Merchant, Edinburgh	1837
Clark, Archibald, Inverchaple, Kilmun	1853
Clark, Francis William, of Ulva	1838
Clark, James, Wormiston, Crail	1842
Clark, John, Plean, Stirling	1851
Clark, Robert, Edinburgh	1845
Clark, Samuel, Manswrae, Kilbarchan	1852
Clarke, Alexander, Eriboll, Tongue	1847
Clarke, Dr John, of Speddoch, M.D., K.H., Deputy Inspector-General of Army Hospitals	1838
Clason, Rev. Dr Patrick, Edinburgh	1838
570 Clayhills, Alexander, of Invergowrie	1838
Cleghorn, George, of Weens	1821
Clerk, James, younger of Penicuik	1847
Clerk, James, Ardtaraig, Dunoon	1853
Clerk, Neil, Balliemore, Dunoon	1853
Clouston, Peter, Merchant, Glasgow	1850
Coats, Peter, of Woodside	1852

		Admitted
	Coats, Thomas, of Ferguslie	1852
	Cobb, William, Mains of Fintray, Dundee	1843
	Cobbold, Charles, Broughton Park, Edinburgh	1842
580	Cobbold, Robert Knipe, Boulge Hall, Saxmundham	1844
	Cochrane, James, of Harburn	1849
	Cochrane, William, New Milton, Roslin	1848
	Cockburn, John George, Harelaw, Chirnside	1850
	Cockburn, Thomas, Sisterpath, Dunse	1851
	Cogan, Hugh, Merchant, Glasgow	1838
	Cogan, John, Merchant, Glasgow	1838
	Cogan, Robert, Merchant, Glasgow	1830
	Coldwells, John, Stobsmills, Fushiebridge	1845
	Cole, Captain William W., Castleton, Lochgilphead	1848
590	Colledge, William, Pollockshields	1850
	Collie, James, Middleton of Fintry, Kintore	1840
	Collie, John, Ardgay, Elgin	1853
	Collier, John, Panlathie, Arbroath	1843
	Collier, Thomas, Hatton, Carnoustie	1835
	Colquhoun, John C., Advocate, Sheriff of Dumbartonshire	1807
	Colquhoun, John Campbell, of Killermont	1824
	Colquhoun, John, Corkerhill, Pollockshaws	1850
	Colquhoun, Ludovic, Advocate, Secretary, Prison Board	1849
	Colquhoun, William Lawrence, of Clathick	1838
600	Colt, John Hamilton, of Gartsherrie	1844
	Con ie, George, Writer, Perth	1852
	Condie, James, Blackfriar's House, Perth	1839
	Connal, William, Merchant, Glasgow	1838
	Connal, William, junior, Glasgow	1850
	Connell, James, of Conheath	1843
	Constable, James Nicoll, of Calley	1843
	Constable, George Nicoll, yr. of Calley	1852
	Conning, John, Writer, Perth	1852
	Cook, John, W.S.	1841
610	Cooper, Henry R., of Ballindalloch	1845
	Cooper, William, of Failford	1845
	Copland, David, Cairnfecle, Aberdeen	1833
	Cordiner, William F., of Memzie, Fraserburgh	1840
	Corrie, Hugh, younger of Steilston	1841
	Corrie, Thomas, of Steilston, Manager, Brit. Linen Co.	1826
	Coubrough, James, Blairtummoch, Campsie	1852
	Coulter, John, Tylefield Street, Glasgow	1833
	Couper, Peter, W.S.	1811
	Coventry, Andrew, of Pittilloch, Advocate	1844
620	Coventry, George Andrew, yr. of Shanwell	1852

		Admitted
	Cowan, Alexander, Merchant, Edinburgh	1810
	Cowan, Charles, M.P., Valleyfield	1836
	Cowan, David, Edinburgh	1844
	Cowan, Hugh, Corstorphine	1852
	Cowan, James, of Dildawn, LL.D.	1852
	Cowan, James G., Edinburgh	1840
	Cowie, David, Dysart, Montrose	1851
	Cowie, James, Mains of Haulkerton, Laurencekirk	1852
	Craig, James, Surgeon, Ratho	1841
630	Craig, James, Holmes Farm, Modiesburn	1850
	Craigie, David, Cashier, Perth Banking Company	1842
	Craigie, Lawrence, of Glendoick	1824
	Cranstoun, George Cranstoun Trotter, of Dewar	1849
	Craufurd, James, yr. of Ardmillan, Advocate, Sheriff of Perthshire	1835
	Craufurd, William Houison, of Craufurdland	1809
	Crawford, Adam, Rhodes, North Berwick	1850
	Crawford, Charles	1822
	Crawford, David, Writer, Greenock	1844
	Crawford, John, of Auchinames	1818
640	Crawfurd, John	1819
	Crawford, William, of Doonside	1836
	Crawford, William Macknight, of Cartsburn	1809
	Crawford, W. S. S., of Milton	1838
	Creyk, Dr Alexander, Pitchaish, Ballindalloch	1850
	Crichton, Andrew, of Shawend, LL.D.	1848
	Crichton, Hew, Edinburgh	1838
	Crichton, Hew Hamilton, W.S.	1849
	Crichton, James Arthur, Advocate	1847
	Crichton, John, of Linn	1849
650	Croall, John, Middlefield House, Edinburgh	1849
	Crombie, Alexander, of Thornton	1835
	Crooks, John, of Leven	1838
	Crosbie, Robert, of Kepp, Merchant, Liverpool	1845
	Cross, David, Seed-Merchant, Glasgow	1845
	Cross, Robert, Hilltown, Dalkeith	1852
	Cruickshank, Alexander, of Keithock	1836
	Cruickshank, Anthony, Aberdeen	1847
	Cruickshank, George, Comisty, Huntly	1852
	Cruickshank, John, Cloves, Elgin	1852
660	Cruickshank, William, of Langley Park	1850
	Crum, John, Thornliebank	1845
	Crum, Walter, of Thornliebank	1844
	Cumine, James, of Rattray	1847
	Cumming, Alex. Penrose Gordon, yr. of Altyre and Gordonston	1846

		Admitted
	Cumming, Charles, Allanaquoich, Braemar	1851
	Cumming, James, Pirlour, Port-William	1841
	Cumming, Lachlan, Muirfield, Inverness	1839
	Cuninghame, Alexander, Craigends	1844
	Cuninghame, David, Chapelton, Ardrossan	1850
670	Cuninghame, John Smith, of Caprington	1835
	Cuninghame, Thomas Smith, younger of Caprington	1835
	Cunningham, Alexander, of Balgonie	1841
	Cunningham, Alexander, Morebattle Tofts, Kelso	1841
	Cunningham, John, Edinburgh	1849
	Cunningham, John, of Lainshaw and Duchrae	1830
	Cunningham, John Sinclair, Banker, Edinburgh	1833
	Cunningham, John Sinclair, Seed-Merchant, Edinburgh	1852
	Cunningham, Thomas, Dalachy, Aberdour	1851
	Cunningham, William A., of Logan	1836
680	Currie, Alexander, Advocate, Sheriff of Banffshire	1836
	Currie, William, of Linthill	1832
	Curror, Adam, Myreside, Burghmuirhead	1849
	Curror, John, Comiston, Colinton	1848
	Curry, Robert, Secretary of the Union Agricultural Society, Kelso	1851
	Cuthbertson, Allan, Accountant, Glasgow	1844
	Cuthbertson, Archibald, Greendykes, Tranent	1822
	Cuthbertson, Donald, Accountant, Glasgow	1827
	Cuthbertson, William, Merchant, Glasgow	1836
	Decazes, The Duc, Honorary Member	1836
690	†Dalhousie, The Right Hon. James, Marquis of, K.T.	1835
	Ducie, Right Hon. Thomas, Earl of	1843
	Dalkeith, The Right Hon. Wm. Henry Walter Montague Douglas Scott, Earl of	1853
	Drumlanrig, The Right Hon. Archibald William, Viscount of, M.P.	1850
	Dupplin, The Right. Hon. George, Viscount	1853
	Dalrymple, The Right Hon. John, Viscount, M.P.	1845
	Duncan, The Right Hon. Adam, Viscount	1843
	†Douglas, The Right Hon. James, Lord	1849
	†Dunfermline, The Right Hon. James, Lord	1834
	Douglas, The Right Hon. Lord William R. Keith, of Denino	1819
700	Dundas, The Right Hon. Sir David, of Ochtertyre	1846
	Dunbar, Sir William, of Mochrum, Bart.	1845
	Dalrymple, Sir Hew, of North Berwick, Bart.	1841
	Dunbar, Sir Archibald, of Northfield, Bart.	1839
	Dunbar, Sir George, of Hempriggs, Bart.	1839

		Admitted
	DOUGLAS, Sir George Henry Scott, of Springwood Park, Bart.	1851
	DUNDAS, Sir David, of Dunira, Bart.	1828
	DRUMMOND, Sir James Walker, of Hawthornden, Bart.	1834
	DAVIE, Sir Henry R. Ferguson, of Creedy, Bart., M.P,	1848
	Dalgairns, Lieutenant-Colonel, Ingliston	1841
710	Dalgleish, Robert Bayne, of Dura	1848
	Dalgleish, A. Stephenson, Merchant, Glasgow	1838
	Dalzell, James Allen, Se cliff	1835
	Dale, John R., Auldhame, North-Berwick	1851
	Dallas, Alexander, Solicitor, Inverness	1853
	Darling, William, Stircoke, Wick	1839
	Darroch, Major Duncan, of Gourock	1840
	Daubeny, Robert Henry, of Bristol	1826
	Davidson, Duncan, of Tulloch	1824
	Davidson, George, Townhead, Balerno	1847
720	Davidson, Henry, Edinburgh	1848
	Davidson, Henry M., Haddington	1841
	Davidson, Hugh, the Customs, Wick	1839
	Davidson, Lawrence, W.S.	1829
	Davidson, Patrick, of Inchmarlo	1834
	Davidson, Robert, Advocate	1819
	Davidson, William, Oldhall, Thurso	1833
	Davidson, William James, of Ruchill, Glasgow	1850
	Davison, John, Brandon Whitehouse, Whittinghame, Northumberland	1852
	Deans, Henry, East Fenton, Haddington	1850
730	Deans, John, Penston, Tranent	1841
	Deans, Peter, Penston, Haddington	1850
	Deas, George, Advocate	1838
	Dempster, George, of Skibo	1823
	Dennistoun, Alexander, junior, Golfhill	1850
	Dennistoun, John, Glasgow	1838
	Denny, Peter, of Castlegreen	1838
	Denoon, David, Merchant, London	1839
	Dewar, Alexander Cumming, Vogrie, H.E.I.C.S.	1832
	Dewar, James, of Vogrie	1842
740	Dewar, John, Advocate	1830
	Dick, William, Veterinary College, Edinburgh	1840
	Dick, William Douglas, of Pitkerro	1828
	Dickinson, Thomas, Magdalenhall, St Boswells	1852
	Dickson, Alexander, Wheatlands, Kirkliston	1848
	Dickson, Archibald, of Huntlaw	1823
	Dickson, David, Laurencekirk	1849
	Dickson, George, of Huntlaw	1830

		Admitted
	Dickson, Henry Gordon, W.S.	1846
	Dickson, James Jobson, Accountant, Edinburgh	1850
750	Dickson, John, of Peelwalls	1838
	Dickson, John, Saughton Mains, Slateford	1844
	Dickson, John, W.S., Perth	1846
	Dickson, Walter, of Monybuie, W.S.	1842
	Dingwall, Walter, Inglismaldie, Montrose, Factor for the Earl of Kintore	1849
	Dingwall, William, Ramornie, Fife	1851
	Dirom, Lieut.-Colonel John, of Mountannan	1838
	Dixon, Thomas Griffies, of Woodcot	1849
	Dixon, William, of Govanhill, Merchant, Glasgow	1827
	Dobbie, John, Campend, Dalkeith	1850
760	Dodd, William, Merchant, Glasgow	1837
	Dodds, John, Cranston Cottage, Ford, Factor to the Earl of Stair	1844
	Dods, William, Seed-Merchant, Haddington	1850
	Donaldson, James, of Keppoch	1845
	Donaldson, John, Advocate	1835
	Dougal, John, of Glenferness	1844
	Douglas, Archibald Pringle, of Adderstone	1822
	Douglas, Archibald, of Glenfinart	1836
	Douglas, Francis Brown, Advocate	1839
	Douglas, James, Athelstaneford, Drem	1848
770	Douglas, James, of Cavers	1835
	Douglas, John Campbell, of Mains	1850
	Douglas, Robert Johnstone, of Lockerbie	1842
	Douglas, Thomas Dunlop, of Dunlop	1838
	Douie, Andrew, Factor, Blair-Adam	1851
	Dove, William, Wark, Kelso	1845
	Downie, Alexander, Merchant, Glasgow	1835
	Downie, John, Merchant, Glasgow	1838
	Drew, Laurence, Merryton, Hamilton	1850
	Drimmie, Daniel, Panmure Bleachfield, Dundee	1843
780	Drummond, Charles Home, Blair-Drummond	1852
	Drummond, George Harley	1810
	Drummond, George Home, yr. of Blair-Drummond	1835
	Drummond, Henry Home, of Blair-Drummond	1809
	Drummond, John Murray, of Megginch	1852
	Drummond, Thomas, of Newton	1828
	Drummond, William, Banker, Cupar-Fife	1837
	Drysdale, James, Seed-Merchant, Glasgow	1852
	Dudgeon, James, Fodderty, Dingwall	1850
	Dudgeon, John, Spylaw, Kelso	1840
790	Dudgeon, John, Almondhill, Kirkliston	1847

		Admitted
	Dudgeon, Patrick, Kailzie, Peebles	1851
	Dudgeon, Robert, Merchant, Liverpool	1828
	Dudgeon, Robert, Humbie, Kirkliston	1849
	Dudgeon, William, Merchant, Leith	1826
	Duff, Alexander, Advocate	1842
	Duff, Rev. David, Minister of Kenmore	1839
	Duff, Garden, of Hatten	1814
	Duff, James, of Delgaty, M.P.	1840
	Duff, James Cunningham Grant, of Eden	1828
800	Duff, Robert, of Fetteresso	1823
	Duff, Richard Wharton, of Orton	1805
	Duff, Thomas Abercromby	1835
	Dunbar, Major P., London	1823
	Duncan, Alexander, of Glendivine	1824
	Duncan, Alexander, of Providence, Rhode Island	1851
	Duncan, George, M.P. for Dundee	1843
	Duncan, George, Balchrystie, Colinsburgh	1838
	Duncan, James, Merchant, Leith	1826
	Duncan, John, Manufacturer, Aberdeen	1840
810	Duncan, Wemyss, Westgarty, Helmsdale	1852
	Duncan, William, S.S.C.	1848
	Dundas, Gabriel Hamilton	1823
	Dundas, George, Advocate, Sheriff of Selkirkshire	1846
	Dundas, Captain Henry, R.N.	1842
	Dundas, John, W.S.	1848
	Dundas, Robert, of Arniston	1847
	Dundas, Lieut-Colonel Thomas, of Carronhall	1839
	Dunlop, Alexander Murray, Advocate, M.P.	1828
	Dunlop, Archibald, London	1823
820	Dunlop, George, Edinburgh	1849
	Dunlop, George, Kilbagie, Stirling	1850
	Dunlop, Henry, of Craigton	1838
	Dunlop, James, of Doonside	1844
	Dunlop, James, of Arthurlee	1844
	Dunlop, John, of Brockloch	1836
	Dunlop, William, Redheughs, Corstorphine	1846
	Dunsmure, James, Edinburgh	1817
	Duthie, Alexander, Advocate, Aberdeen, Secretary, Royal Northern Agricultural Society	1847
	Dykes, Fretcheville Lawson Ballantyne, of Dovenby Hall, Cumberland	1845
830	Dyson, Thos. C., of Willowfield, Halifax, Yorkshire	1832
	Esterhazy, His Highness the Prince, Hungary, Honorary Member	1836

		Admitted
	ELLESMERE, The Right Hon. Francis, Earl of	1822
	†EGLINTON, The Right Hon. Archibald, Earl of, K.T.	1834
	ELGIN and KINCARDINE, The Right Hon. James, Earl of, K.T.	1842
	ELIBANK, The Right Hon. Alexander, Lord	1836
	†ELCHO, The Right Hon. Francis, Lord	1819
	ELPHINSTONE, The Right Hon. John, Lord	1834
	EMLYN, The Right Hon. John Fred., Viscount, M.P.	1839
	ELPHINSTONE, The Hon. Mountstuart	1833
840	ELLIOT, Sir William Francis, of Stobbs, Bart.	1823
	EDMONSTONE, Sir Archibald, of Duntreath, Bart.	1821
	ELPHINSTONE, Sir James Dalrymple Horn, of Horn and Logie-Elphinstone, Bart.	1840
	Eddington, Smollet Montgomery, of Glencreggan	1844
	Eddison, Edwin, Headingly Hill, Leeds	1850
	Edmondston, Thomas, of Buness, Zetland	1838
	Edwards, Allan, Merchant, Dundee	1843
	Edwards, James, Flax-Spinner, Dundee	1844
	Elliot, Adam, M.D., Goldielands, Hawick	1852
	Elliot, James, of Wolflee	1826
850	Elliot, Robert, Hardgrave, Ecclefechan	1848
	Elliot, Robert Kerr, of Hardwood	1849
	Elliot, Thomas, Hindhope, Jedburgh	1852
	Elphinstone, James Anderson	1839
	Elder, John, Merchant, Slate	1815
	Ellice, Edward, yr. of Glenquoich, M.P.	1836
	Elphinstone, Lieutenant-Colonel John	1827
	Errington, John Edward, Civil Engineer, London	1849
	Errington, Rowland, of Sandhoe	1841
	Erskine, Alexander, of Balhall and Longhaven	1843
860	Erskine, Henry, Pitarrow, Laurencekirk	1851
	Erskine, James, of Shielfield, Melrose	1849
	Erskine, Thomas, of Linlathen	1843
	Ewing, Alexander, of Tartowie, M.D., Aberdeen	1841
	Ewing, Alexander, Woodside Place, Glasgow	1844
	Ewing, Archibald Orr, Lennoxbank, Dumbarton	1851
	Ewing, James, of Strathleven	1827
	Ewing, James Lindsay, of Caldercruix	1844
	Ewing, John Orr, Arden, Dumbarton	1838
	Ewing, Robert, Merchant, Greenock	1830
870	Ewing, William, Leckie, of Arngomery	1835
	†FIFE, The Right Hon. James, Earl of, K.T.	1805
	FORBES, The Right Hon. Walter, Lord	1833
	FLAHAULT, Charles, Count Mercer de	1821

Admitted

Forbes, Sir John Stuart, of Pitsligo and Fettercairn, Bart., Honorary Secretary of the Society 1830
Forbes, Sir Charles, of New and Edinglassie, Bart. 1828
Foulis, Sir William Liston, of Colinton, Bart. 1843
Forrest, Sir James, of Comiston, Bart. 1805
Ferguson, Sir Adam, Kt., Keeper of the Regalia 1799
Fairbairn, James, Auctioneer, Kelso 1850
880 Fairlie, Lieutenant-Colonel James, of Holmes 1827
Fairlie, James Ogilvie, of Coodham 1837
Fairrie, John, Merchant, London 1831
Falconar, George, late of Carlowrie 1837
Falconer, Peter, Artrichie, Ellon 1851
Falshaw, James, Civil Engineer, Perth 1849
Farie, James, of Farme 1850
Farquhar, Nathaniel, Advocate, Aberdeen 1840
Farquhar, Arthur, of Elsick, W.S., 1852
Farquharson, Francis, of Finzean 1850
890 Farquharson, Major-General Francis 1843
Farquharson, James, of Invercauld 1831
Farquharson, James, Craig House, Auchinblae 1852
Farquharson, John, of Haughton 1808
Farquharson, Major John, of Corrachrie, Tarland 1841
Farquharson, Robert, of Allargue 1845
Farquharson, Thomas, of Baldovie 1836
Fenton, John, Mill of Mains, Dundee 1843
Fergus, John, of Strathore, M.P. 1832
Ferguson, Captain George, of Pitfour, R.N. 1828
900 Ferguson, James, of Kinmundy 1826
Ferguson, Lieut-Colonel James 1831
Ferguson, James D., Agent on Bywell and Hexham Estates, Newcastle-upon-Tyne 1852
Ferguson, John, of Knockindale 1824
Ferguson, John, Coynach, Secretary, Buchan Agricultural Association 1847
Ferguson, John, Burghlee, Loanhead 1848
Ferguson, Lieut.-Colonel Robert, of Raith, M.P. 1845
Fergusson, Adam, of Woodhill, Canada 1807
Fergusson, John, of Kilquhanity, Castle Douglas 1846
Fergusson, Muir, of Middlehaugh 1842
910 Fergusson, Samuel R., W.S. 1836
Fernie, James Blyth, of Kilmux 1836
Fernie, John Carmichael, Balfarg, Markinch 1853
Fettes, James, Surgeon, Laurencekirk 1850
Findlay, Robert, of Easterhill, Glasgow 1838
Findlay, Thomas Dunlop, Easterhill 1847
Finlay, Alexander Struthers, of Castle Toward 1844

		Admitted
	Findlay, William, of Moss	1851
	Finnie, John, Swanston, Burghmuirhead	1838
	Fisher, Daniel, S.S.C.	1819
920	Fisher, James, M.D.	1821
	Fleeming, John, of Cumbernauld	1851
	Fleming, Alexander, Avon Mills, Hamilton	1850
	Fleming, Andrew, Mains of Fullwood, Paisley	1852
	Fleming, Colonel, of Kinlochlaich	1839
	Fleming, Robert, Glasgow	1838
	Flemying, Robert Stewart, of Killichassie	1826
	Fletcher, Angus, of Dunans	1826
	Fletcher, Angus, Sculptor	1842
	Fletcher, Major C. E.	1848
930	Fletcher, Dugald, Ballachindrain, Cairndow	1853
	Flockhart, John, Flockhouse, Blair-Adam	1851
	Forbes, Alexander, of Boyndlie	1840
	Forbes, Arthur, of Culloden	1850
	Forbes, Arthur, W.S.	1850
	Forbes, Charles Henry, of Kingerloch	1836
	Forbes, Dugald, Writer, Glasgow	1847
	Forbes, Duncan, of Leanachs and Balvraid	1850
	Forbes, George, Banker, Edinburgh	1817
	Forbes, George, Merchant, London	1830
940	Forbes, George, Wine-Merchant, Edinburgh	1835
	Forbes, James D., Professor of Natural Philosophy, University of Edinburgh	1836
	Forbes, James Stewart, Edinglassie	1830
	Forbes, John, of Inverernan	1842
	Forbes, John, of Haddo	1850
	Forbes, John Hay, of Medwyn	1802
	Forbes, Patrick, of St Catharines	1834
	Forbes, William, of Callendar, M.P.	1830
	Forbes, William, yr. of Medwyn, Advocate	1835
	Forbes, William, Newark, Ellon	1852
950	Ford, William, Craigmillar, Edinburgh	1849
	Fordyce, Captain Alexander Dingwall, of Brucklay	1847
	Forlong, William, of Erins	1838
	Forman, John Nairn, W.S.	1831
	Forman, Robert, Windymains, Blackshiels	1852
	Forrest, James, junior, Kirriemuir	1843
	Forrest, William, of Treesbank, Hamilton	1850
	Forrester, John, W.S.	1842
	Forrester, William, Stewarthall, Stirling	1850
	Forrester, William, Lithographer, Edinburgh	1851
960	Forrester, W. A., of Barns	1842
	Forsyth, James, of Dunach	1838

		Admitted
	Forsyth, John, Forres	1826
	Foulds, William, of Skirnieland	1833
	Fowler, Henry Mackenzie, of Fairbairn and Raddery	1846
	Fox, Michael, junior, Glencorse Mains, Penicuik	1849
	Fox, Richard M., of Foxhall, Rathowen, Ireland	1838
	Fraser, Affleck, Inverness	1840
	Fraser, Alexander, City Chamberlain, Aberdeen	1841
	Fraser, Andrew, W.S., Sheriff-Sub., Fort-William	1840
970	Fraser, Colonel Alexander, Royal Engineers	1818
	Fraser, Archibald Thomas Frederick, of Abertarff	1820
	Fraser, Col. Charles, of Inverallochy & Castle Fraser	1816
	Fraser, Evan Baillie, Inverness	1840
	Fraser, Hugh, Abersky, Inverness	1840
	Fraser, Hugh, Balloch of Culloden, Inverness	1853
	Fraser, James B., of Relig	1839
	Fraser, John, London	1840
	Fraser, John, Dumfries	1843
	Fraser, Robert, Brackla, Nairn	1839
980	Fraser, Captain Thomas, of Balnain, R.N.	1839
	Fraser, William, of Glenmead, W.S.	1816
	Fraser, William, of Hillside and Skipness	1838
	Fraser, William, junior, W.S.	1837
	Fraser, William, of Culbokie	1852
	Fraser, William Sutherland, Banker, Dornoch	1850
	Freeland, Robert, of Gryffe Castle	1835
	Fullarton, Gavin, of Kerelaw	1844
	Fullerton, Archibald, of Kilmichael	1846
	Fullerton, Captain James	1824
990	Fullerton, William, Mains of Ardestie, Dundee	1852
	Fyfe, Andrew, M.D., Professor of Chemistry, King's College, Aberdeen	1823
	Fyfe, John of Dalmarnoch	1847
	Gordon, Her Grace Elizabeth, Duchess of	1834
	†Galloway, The Right Hon. Randolph, Earl of	1830
	Glasgow, The Right Hon. James, Earl of	1822
	Gifford, The Right Hon. George, Earl of	1846
	Gray, The Right Hon. John, Lord	1821
	Graham, The Right Hon. Sir James Robert George, of Netherby, Bart. M.P.	1830
	Gordon, Rear Admiral, The Hon. Wm., R.N., M.P.	1824
1000	Gladstone, Sir Thomas, of Fasque, Bart.	1834
	Galbraith, Alexander, Merchant, Glasgow	1850
	Galbraith, Andrew, Merchant, Glasgow	1850
	Galbraith, William, of Blackhouse, Sheriff-Clerk of Stirlingshire	1822

		Admitted
	Galbraith, David Stewart, of Mackrihanish	1812
	Galloway, Alexander, Land-Agent, Glasgow	1850
	Garden, John, Mill of Ardlethen, Ellon	1851
	Garden, William, M.D., Balfling, Aberdeen	1850
	Gardner, Hamilton Gray, W.S.	1844
	Gardner, John, of Springbog	1844
1010	Gardiner, Richard, of Dunhope	1841
	Garland, John, Cairnton, Montrose	1849
	Garland, Thomas, junior, Ardlethen, Ellon	1851
	Gartshore, John Murray, of Gartshore	1825
	Geddes, Adam G., Edinburgh	1819
	Geddes, James, Orbliston, Fochabers	1843
	Geddes, Lieut.-Colonel John, K.H.	1842
	Geekie, Alexander, of Baldourie	1837
	Geekie, Peter, Factor for the Earl of Mansfield at Scone	1837
	Geekie, Robert, of Rosemount	1843
1020	Geils, John Edward, of Dumbuck	1844
	Gentle, Robert, Dell, Inverness-shire	1840
	Gerard, Archibald, of Rochsoles	1842
	Gibb, Elias, Merchant, Glasgow	1838
	Gibbon, Alexander, of Johnston	1834
	Gibbons, Edward, Portree, Skye	1830
	Gibbs, B. T. Brandreth, London	1849
	Gibson, John, W.S.	1825
	Gibson, John, jun., W.S.	1828
	Gibson, John, Woolmet, Dalkeith	1847
1030	Gibson, John, Eastfield, Wiston, Biggar,	1853
	Gibson, Thomas, of Spittal, M.D.	1845
	Gilchrist, Daniel, of Ospisdale	1841
	Giles, James, of Kailzie	1812
	Gilbert, John Graham, of Yorkhill	1847
	Gilkison, Robert, jun., Glasgow	1848
	Gillanders, F. M., of Newmore	1844
	Gillespie, Alexander, M.D., Edinburgh	1806
	Gillespie, Alexander, Merchant, London	1836
	Gillespie, David, of Mountquhannie	1841
1040	Gillespie, James, Craigie, Cramond	1849
	Gillespie, James, Annanbank, Lockerby	1850
	Gillespie, John, W.S.	1846
	Gillespie, Robert, Merchant, London	1829
	Gillespie, Robert, of Cambus-Wallace	1842
	Gillespie, Thomas, Park Hall, Douglas	1842
	Gillespie, Thomas, Ardochy, Fort Augustus	1821
	Gillespie, William, Gateside, Douglas	1829

		Admitted
	Gillon, Andrew, of Wallhouse	1848
	Gilly, Rev. William Stephen, D.D., Vicar of Norham	1840
1050	Gilmour, Allan, of Eaglesham	1849
	Gilmour, Walter James Little, of Craigmillar	1828
	Girdwood, John, Chirk, North Wales	1845
	Gladstone, Robertson, Merchant, Liverpool	1841
	Glasgow, Alexander, of Old Court, Cork	1847
	Glasgow, R. Robertson, of Montgreenan, Sheriff-Substitute of Renfrewshire	1838
	Glen, John, Merchant, Edinburgh	1847
	Glen, Thomas, Hillhead, Paisley	1853
	Glen, William, Hawkhead Mains, Paisley	1850
	Glendinning, George, Factor, Hatton Mains, Ratho	1849
1060	Glendinning, Peter, Dalmeny Park, Queensferry	1848
	Glennie, Arthur, Fernieflat, Bervie	1851
	Goodlet, William, Factor for Lord Blantyre, Freeland, Renfrewshire	1851
	Goodsir, John, Professor of Anatomy, University of Edinburgh	1846
	Goodwin, Lieut.-Colonel Hugh Maxwell, of Mount Alyn, Denbighshire	1830
	Gordon, Alexander, of Ellon	1808
	Gordon, Alexander, of Newton	1841
	Gordon, Charles, of Auchleuchries	1832
	Gordon, Captain Charles, R.N.	1835
	Gordon, Charles Napier, of Esslemont	1840
1070	Gordon, Edward Strathearne, Advocate, Edinburgh	1840
	Gordon, Francis, of Kincardine	1835
	Gordon, George, Banff	1829
	Gordon, James, of Manar	1835
	Gordon, James, of Ivybank	1813
	Gordon, James, of Xeres-de-la-Frontera	1834
	Gordon, James Adam, of Knockespock	1843
	Gordon, John, of Avochie	1846
	Gordon, Colonel John, of Cluny	1807
	Gordon, John, of Cairnbulg	1811
1080	Gordon, John, of Aikenhead	1838
	Gordon, John, Lettoch, Glenlevit	1853
	Gordon, John Taylor, of Nethermuir and Blackhouse	1831
	Gordon, John Thomson, Advocate, Sheriff of Edinburgh	1841
	Gordon, Joseph, W.S.	1804
	Gordon, Michael Francis, of Abergeldie	1831
	Gordon, Peter Charles, of Wardhouse	1834
	Gordon, Peter Laing, of Craigmyle	1834
	Gordon, Lieut.-Colonel, R.A., Culdrain, Huntly	1850

		Admitted
	Gordon, Richard, Accountant, Edinburgh	1845
1090	Gordon, Robert, of Jamaica	1802
	Gordon, Robert Macartney, of Rattra	1846
	Gordon, Lieut.-Colonel Thomas, of Park	1825
	Gordon, William, of Culvennan	1845
	Gordon, William, Aberdeen	1847
	Gordon, Major-General W. A., of Lochdhu, C.B.	1818
	Gordon, Captain William Cosmo, of Fyvie	1847
	Govan, John, W.S.	1809
	Gow, John L., Factor, Raith, Kirkcaldy	1851
	Græme, Major George Drummond, of Inchbraikie	1839
1100	Graham, Colonel David, of Meiklewood	1831
	Graham, Frederick, Edinburgh	1821
	Graham, Alexander, of Capilly	1844
	Graham, Charles Maxwell, Glasgow	1844
	Graham, George	1817
	Graham, George, of Shaw	1826
	Graham, Humphrey, W.S.	1819
	Graham, James, of Leitchtown	1827
	Graham, James, of Fereneze	1843
	Graham, James, Meikle Culloch, Dalbeattie	1851
1110	Graham, James Gillespie, of Orchill	1806
	Graham, James Maxwell, Glasgow	1844
	Graham, John, Newbigging, Lockerby	1829
	Graham, John, Pearsie, Kingoldrum	1843
	Graham, John, younger of Shaw	1852
	Graham, Robert, of Redgorton	1817
	Graham, Robert, Merchant, Leith	1826
	Graham, Robert C. Cunningham, of Gartmore	1823
	Graham, Thomas, of Ballewan, M.D., F.R.S., Professor of Chemistry, University College, London	1849
	Graham, Thomas, younger of Balfunning	1851
1120	Graham, William, Writer, Glasgow	1828
	Graham, Colonel William, of Mossknow	1834
	Graham, William, jun., of Finnartmore	1844
	Graham, William Stirling, of Airth	1833
	Grainger, John, Factor to the Marquis of Lothian, Harestanes, Jedburgh	1836
	Grant, Alexander, of Aberlour	1810
	Grant, Major Charles, Aberdeen	1816
	Grant, Dougal, Edinburgh	1833
	Grant, Duncan, of Bught	1825
	Grant, George, Liverpool	1840
1130	Grant, George, of Limepots, Advocate, Sheriff-Substitute of Fifeshire	1846

		Admitted
	Grant, Rev. James, D.D., Edinburgh, Chaplain to the Society	1828
	Grant, James Augustus, of Viewfield	1840
	Grant, James M., of Glenmoriston and Moy	1810
	Grant, John, of Kilgraston	1819
	Grant, John Peter, W.S.	1823
	Grant, Hay Macdowall, of Arndilly	1852
	Grant, Lewis, Kincorth, Morayshire	1846
	Grant, Patrick, W.S., Sheriff-Clerk of Inverness-shire	1836
	Grant, Peter, Weirach, Ballindalloch	1852
1140	Grant, Robert, of Kincorth	1826
	Grant, Robert, of Tillyfour	1830
	Grant, Robert, of Craighall	1841
	Grant, Robert, Bookseller, Edinburgh	1842
	Grant, Thomas Macpherson, W.S.	1846
	Grant, Walter Colquhoun	1844
	Grant, William, younger of Elchies	1833
	Grant, William, Australia	1839
	Grant, William Forsyth, of Ecclesgreig	1849
	Grant, W. P., of Rothiemurchus	1821
1150	Grassick, Charles	1830
	Grassick, John, Mains of Glenbucket	1829
	Grassick, Patrick, Glenogle, Aberdeen	1842
	Gray, Andrew Farquhar, of Glentig	1835
	Gray, Charles, Distiller, Glasgow	1838
	Gray, James, Bearside, Stirling	1851
	Gray, James, of Auchengeich	1843
	Gray, John, Merchant, Greenock	1831
	Gray, John, Edinburgh	1848
	Gray, John W., Edinburgh	1848
1160	Gray, Roderick, Factor at Peterhead for the Merchant Hospital of Edinburgh	1829
	Gray, Stephen, of Mansfield	1838
	Gray, William, Kingston, North Berwick	1849
	Gray, William, Southfield, Portobello	1849
	Greenhill, David, of Craignathro	1842
	Greenshields, John, of Kerse	1829
	Greg, John, Oatfield, Campbeltown	1850
	Gregory, Arthur Thomas, of Buchromb	1833
	Gregory, William, M.D., Professor of Chemistry, University of Edinburgh	1845
	Greig, James, of Eccles, W.S.	1809
1170	Greig, John Rutherford, of Lethangie	1833
	Greig, John, younger of Lethangie	1846
	Greig, Thomas, of Glencarse	1852

		Admitted
	Gregorson, Angus, Banker, Oban	1851
	Grierson, James, Caigton, Castle-Douglas	1851
	Grieve, James, Branxholm Braes, Hawick	1842
	Grieve, Thomas, Skelf-hill, Hawick	1839
	Grieve, William of Branxholm Park, Hawick	1834
	Grigor, John, Forres Nurseries, Forres	1847
	Grindlay, Richard, Merchant, Leith	1842
1180	Gulland, James, Newton of Wemyss, Kirkcaldy	1851
	Gulland, William Erskine, of Stripeside	1833
	Gunn, Alexander, Dalemore, Thurso	1850
	Gunn, George, Rhives, Golspie, Factor on the Estate of Sutherland	1821
	Gunn, Marcus, Ratter, Thurso	1849
	Gunn, James, Glendhue, Golspie	1839
	Gunn, William, Glendhue, Golspie	1839
	Guthrie, David, of the *North British Agriculturist*, Edinburgh	1850
	Guthrie, George, Factor to the Earl of Stair, Stranraer	1839
	Guthrie, Major Davidson, of Argeath, Perth	1826
1190	Guthrie, John, of Guthrie	1836
	Gwynne, Alban Thomas Jones, of Monachty, Cardiganshire	1834
	*HAMILTON and BRANDON, His Grace William Anthony Alexander, Duke of, President of the Society	1834
	†HUNTLY, the Most Noble George, Marquis of, K.T.	1793
	†HOME, The Right Hon. Cospatrick, Earl of	1843
	†HADDINGTON, The Right Hon. Thomas, Earl of	1804
	HADDO, The Right Hon. George, Lord	1848
	HAY, Major-General The Right Hon. Lord James	1847
	HALLYBURTON, The Right Hon. Lord John Frederick Gordon, of Pitcur	1844
	HOPE, The Right Hon. John, Lord Justice-Clerk	1823
1200	HOPE, Sir John, of Craighall, Bart., M.P.	1808
	HAY, Sir Adam, of Smithfield and Hayston, Bart.	1825
	HALL, Sir John, of Dunglass, Bart.	1829
	HAY, Sir James Dalrymple, of Park Place, Bart.	1816
	HEPBURN, Sir Thomas Buchan, of Smeaton-Hepburn, Bart.	1837
	HOUSTOUN, Lieut.-General Sir Robert, of Clerkington, K.C.B.	1833
	HAY, Sir Andrew Leith, of Rannes	1819
	Hadden, Alexander, of Persley	1840

		Admitted
	Hagart, Thomas, of Bantaskine	1826
	Haggart, James Valentine, of Glendelvino	1844
1210	Haig, Alexander, of Blairhill	1833
	Haig, John, Cameron Distillery, Kirkcaldy	1841
	Haldane, Robert, Banker, Galashiels	1851
	Hall, James, younger of Dunglass	1849
	Hall, Henry, Coul, Dornoch	1846
	Hall, John, Scibercross, Golspie	1841
	Hall, John, of Mollance	1841
	Hamilton, James, Whiteshaw Gate, Avondale	1850
	Hamilton, John, of Sundrum	1839
	Hamilton, John, of Fairholm	1827
1220	Hamilton, John, of Greenbank	1846
	Hamilton, John Buchanan, of Leny and Bardowie	1846
	Hamilton, Lieut.-Colonel John Ferrier, of Westport and Cairnhill	1827
	Hamilton, Robert, W.S., Tiretigan, Tarbert	1842
	Hamilton, Robert William, Agent, General Steam Navigation Company, Edinburgh	1814
	Hamilton, Walter Ferrier, younger of Westport and Cairnhill	1848
	Hamilton, William, of Craighlaw	1852
	Hamilton, William, Merchant, Glasgow	1823
	Handyside, Robert, Advocate, Solicitor-General	1841
	Handyside, William, Cornhill, Biggar	1843
1230	Hanning, John, Skipmyre, Dumfries	1840
	Harden, Robert Allan, Edinburgh	1838
	Hardie, George, Orwell, Kinross	1851
	Hardie, Robert, Harrietfield, Kelso	1851
	Hare, Steuart Bayley, of Calderhall	1849
	Harland, Wm. Chas, of Sutton Hall, York	1852
	Harper, Frank, Valuator and Appraiser, Dingwall	1853
	Harthill, John, Edinburgh	1846
	Harvey, Arthur, Tillygreig, Aberdeen	1838
	Harvey, C. W., Merchant, Liverpool	1846
1240	Harvey, George, Haddington	1850
	Harvey, J. W., of Carnousie	1851
	Harvey, John, of Ichwell, Bury, and Tiningly Park, Yorkshire	1809
	Harvey, John Rae Lee, of Castle Semple	1836
	Harvey, John Inglis, of Kinnettles	1845
	Harvey, Robert, of Pennygowan	1845
	Harvey, William, Distiller, Yoker	1838
	Harvie, Rev. William, of Brownlee, Carluke	1852
	Harvie, Robert, Distiller, Port-Dundas	1838

		Admitted
	Hastie, Alexander, M.P. for Glasgow	1843
1250	Hastie, Archibald, M.P. for Paisley	1838
	Haxton, John, Drumnod, Cupar-Fife	1850
	Hay, Adam, W.S.	1846
	Hay, Alexander, of Hardengreen	1837
	Hay, David Ramsay, Edinburgh	1822
	Hay, George William, of Whiterigg	1841
	Hay, Rear-Admiral James, of Belton	1820
	Hay, James, Little Ythsie, Ellon	1852
	Hay, James, Merchant, Leith	1828
	Hay, James Richardson, of Seggieden	1847
1260	Hay, John, of Letham Grange	1834
	Hay, Captain John Charles Dalrymple, younger of Park Place	1848
	Hay, John Stewart, of Rockville	1836
	Hay, Robert, Rechleirach, Ballindalloch	1852
	Hay, Samuel, Manager, Union Bank of Scotland	1846
	Hay, William, of Hayfield	1828
	Hay, William, of Dunse Castle	1819
	Hay, William, of Hopes	1835
	Hay, William, Shethin, Tarves	1847
	Hay, William, Barbachlaw, Musselburgh	1853
1270	Heathcoat, John, Honorary Member	1837
	Hector, Alexander, Writer, Edinburgh	1824
	Hector, Robert, Kintrockat, Brechin, Factor for Mr Carnegy of Craigo	1848
	Henderson, Alexander, Longniddry, Tranent	1837
	Henderson, Alexander, Gourdie House, Dunkeld	1843
	Henderson, Alexander, younger of Stemster	1847
	Henderson, Charles J., Corn-Merchant, Leith	1847
	Henderson, Captain David, of Stemster	1829
	Henderson, David, of Gattaway, Newburgh	1850
	Henderson, Duncan, M.D.	1825
1280	Henderson, Eagle, Merchant, Edinburgh	1848
	Henderson, G. D. Clayhills, Hallyards, Perthshire	1843
	Henderson, James, of Bilbster	1839
	Henderson, James, Perth	1851
	Henderson, John, Byres, Haddington	1850
	Henderson, John, W.S., Banker, Thurso	1839
	Henderson, John, of Park	1838
	Henderson, Major John Alexander, of Westerton	1831
	Henderson, John Irving, Advocate, Sheriff-Substitute, Dundee	1823
	Henderson, William, Craigarnhall, Stirling	1851
1290	Henderson, William Scott, W.S.	1850

		Admitted
	Hepburn, John Stewart, of Colquhalzie	1810
	Hepburn, John Buchan, of Castle Dykes	1845
	Hepburn, R. W. R., of Riccarton	1849
	Heriot, Frederick L. Maitland, of Ramornie	1851
	Heriot, John, of Foley Hills	1828
	Herries, William Young, of Spotts	1823
	Hewatson, Robert, Auchenbenzie	1834
	Hewetson, Walter, Kirkhouse, Kirkbean	1851
	Hill, David, Bannatyne House, Newtyle	1852
1300	Hill, George Gosset, Merchant, London	1823
	Hill, Henry David, W.S.	1825
	Hill, James Lawson, W.S.	1847
	Hill, John, Easter Carlowrie, Kirkliston	1850
	Hill, Lawrence, of Barlanark, Writer, Glasgow	1838
	Hill, Norman, of Brownhills, Advocate	1807
	Hill, Robert, Golspie Tower Farm, Golspie	1851
	Hobbs, Wm. Fisher, of Boxted Lodge, Colchester	1848
	Hodgson, Richard, of Carham, Northumberland	1850
	Hog, James Maitland, of Newliston and Kellie	1835
1310	Hogarth, George, Banker, Cupar-Fife	1842
	Hogarth, John, Akeld, Northumberland	1841
	Holmes, James, of Kirkstyle, Dalserf	1850
	Home, Francis, Sheriff-Substitute, Linlithgow	1829
	Home, Major-General J. H., of Bassendean	1834
	Home, G. H. Binning, of Argaty	1831
	Home, David Milne, of Wedderburn, Advocate	1835
	Home, Captain George Logan, of Broomhouse	1852
	Hood, David, of Balluderon	1834
	Hood, John, of Stoneridge	1827
1320	Hope, Archibald, younger of Craighall and Pinkie	1832
	Hope, Andrew, Queen Street, Edinburgh	1851
	Hope, George, Fenton Barns, Drem	1848
	Hope, George William, of Luffness and Rankeillor	1848
	Hope, James, Duddingston, Portobello	1847
	Hope, James, W.S., Wardie	1848
	Hope, John, South Elphinstone, Tranent	1851
	Horn, John, of Thomanean	1837
	Horn, Robert, Advocate	1851
	Horne, Archibald, Accountant, Auditor of Accounts to the Society	1828
1330	Horne, Donald, of Langwell	1817
	Horne, James, Civil Engineer, Edinburgh	1848
	Horne, James, younger of Langwell, 71st Highland Light Infantry	1846
	Horne, Thomas Elliot Ogilvie, W.S., Edinburgh	1851

		Admitted
	Horne, William, of Scouthell, Advocate, Sheriff of Haddington	1813
	Horrocks, John	1818
	Horrop, Isaac W., The Cairnies, Perth	1846
	Horsburgh, Major William Henry	1824
	Horsburgh, Robert, Factor for the Duke of Sutherland, House of Tongue	1841
	Hozier, James, of Newlands	1822
1340	Hotchkis, James, Dumfries	1838
	Houldsworth, Henry, of Cranstonhill	1836
	Houldsworth, John, Merchant, Glasgow	1838
	Houston, Thomas, Kintradwell, Dornoch	1821
	Houstoun, Lieut.-Colonel A., younger of Clerkington	1845
	Houstoun, Ludovic, of Johnstone Castle	1823
	Howard, Lieut.-Colonel	1809
	Howat, Robert Kirkpatrick, of Mabie	1841
	Howden, Francis, Factor, Falkland	1842
	Howden, Robert, Boggs, Pencaitland	1850
1350	Howden, James, Jeweller, Edinburgh	1827
	Hubback, Thomas, Sunlawshill, Kelso	1851
	Huggins, W. B., Glasgow	1844
	Hughan, Thomas, of Airds	1838
	Hume, Joseph, Lochcote	1848
	Hume, Mathew Norman Macdonald, W.S.	1818
	Hume, Peter Hallyburton, Lawfield, Dunbar	1840
	Hunt, James, of Pittencrieff and Logie	1836
	Hunt, James Alexander, of Chamberfield	1849
	Hunt, William, younger of Pittencrieff and Logie	1836
1360	Hunter, Alexander, W.S.	1824
	Hunter, Andrew, of Bonnieton	1819
	Hunter, Charles	1823
	Hunter, David, of Blackness	1826
	Hunter, Captain James, N. B. Staff, Edinburgh	1847
	Hunter, James, Edinburgh	1823
	Hunter, Captain James, of Auchterarder	1823
	Hunter, James, of Hafton	1833
	Hunter, James, Coltness, Wishaw	1852
	Hunter, James William, of Thurston	1842
1370	Hunter, John, Oxenford Mains, Ormiston	1842
	Hunter, John, Dipple, Fochabers	1851
	Hunter, Richard, H.E.I.C.S.	1837
	Hunter, Robert, Glenocher, Abington	1842
	Hunter, Robert, Advocate, Sheriff of Buteshire	1843
	Hunter, William, of Ormiston	1812
	Hutchinson, James, Merchant, Glasgow	1838

		Admitted
	Hutchison, Graham, Merchant, Glasgow	1838
	Hutchison, John, Monyruy, Peterhead	1841
	Hutchison, Robert, Merchant, Glasgow	1838
1380	Hutchison, Robert, of Cairngall	1829
	Hutchison, Robert, Fosterton, Kirkcaldy	1850
	Hutton, Thomas, Bridgeton, Montrose	1844
	Hyett, Henry W., Painswick	1841
	IVORY, The Hon. Lord	1833
	INNES, Sir James Milne, of Edingight, Bart.	1838
	Inglis, Charles Craigie Halkett, of Cramond	1834
	Inglis, Harry Maxwell, of Logan Bank, W.S.	1847
	Inglis, Henry, W.S.	1849
	Inglis, James P.	1806
1390	Inglis, John, Dean of the Faculty of Advocates	1852
	Innes, Alexander, of Cowie	1840
	Innes, Alexander Mitchell, younger of Ayton	1842
	Innes, Cosmo, Principal Clerk of Session	1840
	Innes, George Mitchell, of Ingliston and Bangour	1847
	Innes, John B., W.S.	1847
	Innes, Thomas Mitchell, of Phantassie	1842
	Innes, Thomas, of Lairney	1846
	Innes, William Mitchell, of Ayton	1819
	Innes, William, of Raemoir	1834
1400	Irvine, Alexander Forbes, of Drum	1805
	Irvine, Alexander Forbes, younger of Drum	1845
	Irvine, Rev. A. Robertson, Blair-Atholl	1838
	Irvine, Patrick, of Inveramsay, W.S.	1827
	Irvine, William Stewart, M.D., Pitlochrie	1843
	Irving, George Vere, of Newton	1844
	Irving, John, London	1838
	JOHNSTONE, The Hon. Hen. Butler, of Corehead, M.P.	1842
	JARDINE, Sir William, of Applegarth, Bart.	1823
	JOHNSTON, Sir William, of Kirkhill	1848
1410	Jameson, Melville, Writer, Perth	1852
	Jameson, Robert, Professor of Natural History, University of Edinburgh	1820
	Jardine, Andrew, of Lanrick	1846
	Jardine, James, Civil Engineer, Edinburgh	1818
	Jardine, James, of Larreston	1846
	Jardine, Alexander, younger of Applegarth	1850
	Jeffreys, Captain George, of Sunwick	1840
	Jobson, Robert, Auchterhouse, Dundee	1843
	Johnston, Alexander, W.S.	1836

		Admitted
	Johnston, Alex., Hailes, Ratho	1852
1420	Johnston, Andrew, of Halleaths	1838
	Johnston, Rear-Admiral Charles James, of Cowhill	1830
	Johnston, George, Factor to the Earl of Eglinton and Winton	1822
	Johnston, James F. W., Durham	1846
	Johnston, John	1833
	Johnston, John, Ballencrieff Mains, Bathgate	1852
	Johnston, Robert, Merchant, Aberdeen	1839
	Johnston, Robert, of Shieldhall	1851
	Johnston, William, of Lathrisk	1849
	Johnston, William, Writer, Bathgate	1852
1430	Johnstone, Alexander, W.S.	1819
	Johnstone, Charles Kinnaird, K.L.S.	1839
	Johnstone, Christopher, Townfoot, Dumfriesshire	1850
	Johnstone, James, of Alva, M.P.	1828
	Johnstone, John James Hope, of Annandale	1824
	Jollie, Walter, W.S.	1829
	Jolly, David Leitch, Banker, Perth	1829
	Jolly, Stewart, Catter, Dumbarton	1827
	Jolly, William Gairdner, Catter, Dumbarton, Chamberlain to the Duke of Montrose	1845
	Jopp, Alexander, Advocate, Aberdeen	1834
1440	KINTORE, The Right Hon. Francis Alexander, Earl of	1850
	†KINNOUL, The Right Hon. Thomas, Earl of	1806
	†KINNAIRD, The Right Hon. George William, Lord	1830
	KENNEDY, The Right Hon. T. F., of Dunure	1812
	KINLOCH, Sir David, of Gilmerton, Bart.	1828
	Kaye, Robert, of Millbrae	1844
	Keir, Andrew T., Noss, Wick	1849
	Keir, Patrick Small, of Kinmonth	1805
	Keir, Patrick, younger of Kinmonth	1837
	Keith, William, Accountant, Edinburgh	1821
1450	Kemp, John, yr. of Hallydown	1852
	Kennedy, Donald, of Bogbain	1838
	Kennedy, Gilbert, Glasgow	1838
	Kennedy, Captain Hew Fergusone, of Bennand and Finnart	1832
	Kennedy, James, Myremill, Maybole	1850
	Kennedy, John, of Kirkland	1839
	Kennedy, John, of Knocknalling, Ardwick House, Manchester	1830

		Admitted
	Kennedy, John, of Underwood, W.S.	1836
	Kennedy, John Lawson, younger of Knocknalling	1846
	Kennedy, Primrose William, of Drumellan	1842
1460	Kennedy, Robert Thomson, of Daljarrock	1833
	Kennedy, Thomas, Nursery and Seedsman, Dumfries	1845
	Kennedy, William	1842
	Ker, Robert, of Argrennan	1842
	Kerr, Christopher, Dundee, Factor for Lord Wharncliffe	1843
	Kerr, James, of Middlebank, Dunfermline	1838
	Kerr, Robert, Surgeon, Portobello	1816
	Kerr, William Scott, of Chatto	1833
	Kerr, William Williamson, Oriel College, Oxford	1845
	Kidston, Archibald G., Glasgow	1844
1470	Kidston, John P., Newton House, Cambuslang	1850
	Kilgour, Robert, jun., Millbank, Aberdeen	1826
	King, James Foster, Wester Longhaugh, Bishopton	1850
	King, William, Manufacturer, Glasgow	1839
	Kinloch, Alexander John, of Park and Maryculter	1841
	Kinloch, George, of Kinloch	1825
	Kinloch, Colonel John, of Kilrie	1829
	Kinnear, Charles, of Kinloch	1824
	Kirk, John, W.S., Edinburgh	1848
	Kirkaldy, George D. H., of Hearensbrooke, Ireland	1844
1480	Kirkaldy, James, Balgillo, Broughty Ferry	1839
	Kirkwood, Robert, High Longmuir, Kilmaurs	1852
	Knight, George, of Jordanstown	1833
	Kyle, Captain Alexander, of Binghill	1835
	LEINSTER, His Grace Augustus, Duke of, Hon. Mem.	1841
	LANSDOWNE, The Most Noble Henry, Marquis of, K.G., Honorary Member	1837
	†LEVEN and MELVILLE, The Right Hon. David, Earl of	1820
	†LOVAT, The Right Hon. Thomas Alexander, Lord	1820
	LOVAT, The Hon. Simon Fraser, Master of	1853
	LIVINGSTONE, Rear-Admiral Sir Thomas, of West Quarter, Bart.	1815
1490	LAUDER, Sir John Dick, of Fountainhall, Bart.	1848
	LAMB, Sir Charles, of Beauport, Bart.	1836
	LEITH, Lieut.-General Sir Alex., of Freefield, K.C.B.	1811
	LINDSAY, Lieut.-Colonel Sir Martin	1816
	L'Amy, James, of Dunkenny, Sheriff of Forfarshire	1806
	Laidlaw, Robert, Netherorsock, Dumfries	1833
	Laing, Rev. Francis, of Carselogie	1824

		Admitted
	Laing, Robert, Addinstone, Lauder	1850
	Laing, Robert, Town-Clerk of Jedburgh	1851
	Laird, David, of Strathmartine	1833
1500	Lamont, Alexander, of Knockdow	1819
	Lamont, Archibald James, of Lamont	1840
	Lamont, James, of Benmore	1850
	Lamont, Robert, Writer, Glasgow	1838
	Lang, Hugh M., of Blackdales, Largs	1849
	Laurie, John, of Maxwellton	1840
	Laurie, Robert, Merchant, Leith	1834
	Laurie, Thomas, Terreglestown, Dumfries	1848
	Laurie, William Kennedy, of Woodhall	1848
	Law, Robert, Engineer, Shettleston, Glasgow	1838
1510	Lawrie, William, Fairneyflatt, Slateford	1850
	Lawson, Alexander, of Burnturk	1853
	Lawson, Alexander, Merchant, Dundee	1843
	Lawson, Archibald, West Barns, Dunbar	1850
	Lawson, Charles, Seedsman, and Conservator of the Museum of the Society	1830
	Lawson, Charles, junior, Edinburgh	1846
	Lawson, John, of Chapelton	1832
	Leadbetter, John, Merchant, Glasgow	1838
	Learmonth, John, of Dean	1814
	Learmonth, Thomas	1824
1520	Ledingham, Robert, of Wateridgemuir, Aberdeen	1840
	Leigh, Rev. Peter, Golborne Park, Lancashire	1823
	Leighton, William, Huttonbank, Hamilton	1831
	Leith, Alexander, yr. of Freefield and Glenkindy	1841
	Leith, John, Langley Park, Wick	1850
	Lennox, John L. Kincaid, of Woodhead	1824
	Leslie, Angus, Pronsinain, Golspie	1830
	Leslie, George Abercromby Young, of Kininvie	1840
	Leslie, Hans George, of Dunlugas	1826
	Leslie, Robert, of Rothie	1845
1530	Leslie, William, of Drumrossie	1848
	Leslie, William, of Warthill	1826
	Leny, James Macalpine, of Dalswinton	1824
	Liddell, Andrew, Merchant, Glasgow	1839
	Liddell, James, Auchtertool House, Kirkcaldy	1843
	Lindsay, Alexander K., of Balmungo	1841
	Lindsay, Donald, Accountant, Edinburgh	1843
	Lindsay, General James, of Balcarres	1823
	Lindsay, John Mackenzie, Corn-Merchant, Dundee	1826
	Lindsay, John Mackenzie, W.S.	1846

		Admitted
1540	Lizars, William Home, Edinburgh	1835
	Loch, James, of Kirktomy	1822
	Loch, George, 12 Albemarle Street, London	1853
	Lockhart, Alexander Macdonald, Carnwath	1835
	Lockhart, Allan Eliott, of Borthwickbrae, M.P.	1832
	Lockhart, James Sinclair, of Castlehill	1846
	Lockhart, John, Factor, Dunmore Park, Falkirk	1849
	Lockhart, Norman, of Tarbrax	1815
	Lockhart, Robert, Glasgow	1850
	Lockhart, William, of Milton-Lockhart, M.P.	1836
1550	Logan, Alexander, London	1831
	Logan, Alexander S., Advocate	1848
	Logan, Robert, Mains, Kilbirnie	1850
	Logan, Robert, of Corramore, Surgeon, Lanark	1844
	Longmore, Andrew, Rettie, Banff	1852
	Longmore, John Alexander, W.S.	1837
	Lorimer, James, of Kellyfield, Factor to the Earl of Kinnoul	1826
	Lorimer, Thomas Webster, Aberdalgie, Perth	1843
	Louson, David, Town-Clerk of Arbroath	1813
	Low, David, of Laws, Professor of Agriculture, University of Edinburgh	1825
1560	Low, James, Berrywell, Dunse	1843
	Low, Colonel John, C.B.	1844
	Low, Lieut.-Colonel Robert	1841
	Lowndes, James, of Arthurlee	1850
	Lumsdaine, Rev. Edwin Sandys, of Blanerne and Inergelly	1837
	Lumsdaine, James, of Lathallan	1833
	Lumsden, Benjamin, of Kingsford	1828
	Lumsden, George, Leslie Lodge, Keith Hall	1850
	Lumsden, Henry, of Auchindoir	1830
	Lumsden, Hugh, of Pitcaple, Sheriff of Sutherlandshire	1825
1570	Lumsden, James, Braco, Keith	1840
	Lumsden, James, Glasgow	1838
	Lumsden, James, jun., Glasgow	1844
	Lumsden, William James, of Balmedie	1841
	Lumsden, Lieut.-Colonel Thomas, of Belhelvie	1851
	Lyall, Charles, Kincraig, Brechin, Factor for Sir James Carnegie of Southesk, Bart.	1850
	Lyall, Robert, Carcary, Brechin	1850
	Lyall, Robert, Old Montrose	1826
	Lyall, Robert, Merchant, Glasgow	1843

Admitted

Lyell, Thomas, R.N., Kinnordy, Kirriemuir 1836
1580 Lyon, George, of Glenogil 1809
Lyon, John Stewart, of Kirkmichael 1837

*MONTROSE, His Grace James, Duke of, K.T. 1821
MARCH, The Right Hon. Charles, Earl of, M.P. 1840
†MORTON, The Right Hon. George Sholto, Earl of 1828
†MANSFIELD, The Right Hon. David, Earl of 1833
MANSFIELD, The Right Hon. the Dowager Countess of 1840
†MINTO, The Right Hon. Gilbert, Earl of, G.C.B. 1808
MACDONALD, The Right Hon. Godfrey William Wentworth, Lord 1833
MACKENZIE, The Right Hon. Holt 1833
1590 MACAULAY, The Right Hon. T. B., M.P. 1839
MACLAREN, The Right Hon. Duncan, Lord-Provost of the City of Edinburgh 1853
M'NEILL, The Right Hon. Duncan, of Colonsay, Lord Justice-General 1833
MAITLAND, Rear-Admiral the Hon. Sir Anthony 1831
MAULE, Lieut.-Colonel The Hon. Lauderdale, M.P. 1852
MAULE, The Hon. William Maule, of Maulesden 1846
MACDONALD, The Hon. Archibald 1796
MURRAY, The Hon. Major David 1840
MELVILLE, The Hon. William Leslie 1833
MORETON, The Hon. Augustus Henry Macdonald, of Largie 1844
1600 MACKENZIE, The Hon. Mrs Stewart, of Seaforth 1816
MURRAY, The Hon. Lord 1823
MAXWELL, Sir W. A., of Calderwood, Bart. 1830
MENZIES, Sir Robert, of Menzies, Bart. 1841
MENZIES, The Hon. Lady, of Menzies 1839
MURRAY, Sir William Keith, of Ochtertyre, Bart. 1830
MAXWELL, Sir John, of Polloc, Bart. 1825
MAXWELL, Sir William, of Monreith, Bart. 1840
MAXWELL, Sir John Heron, of Springkell, Bart. 1839
MONCRIEFFE, Sir Thomas, of Moncrieffe, Bart. 1843
1610 MACKENZIE, Sir Jas. John Randoll, of Scatwell, Bart. 1838
MACKENZIE, The Right Hon. Lady Anne, of Scatwell 1841
MILLER, Sir William, of Glenlee, Bart. 1837
MONTGOMERY, Sir Graham Graham, of Stanhope, Bart., M.P. 1843
MAXWELL, Sir David, of Cardoness, Bart. 1810
MACKENZIE, Sir John Muir, of Delvin, Bart. 1829
MAITLAND, Sir Alexander Charles Gibson, of Cliftonhall, Bart. 1847

		Admitted
	Mackenzie, Sir Evan, of Kilcoy, Bart.	1846
	Menteath, Sir Jas. Stuart, of Mansfield, Bart.	1837
	Mansel, Sir John, Bart.	1840
1620	Mactaggart, Sir John, of Ardwell, Bart., M.P.	1839
	Matheson, Sir James, of Lewis, Bart., M.P.	1843
	M'Neill, Sir John, G.C.B., Edinburgh	1846
	Macdonell, Lieut.-General Sir James, K.C.B.	1803
	Macleod, Major-General Sir John, of Unish	1804
	Macadam, John, of Blairover	1824
	Macalister, Alexander, of Loup and Torrisdale	1840
	Macalister, Major James, of Springbank	1807
	Macalister, Keith Macdonald, of Inistrynish	1829
	Macalister, Keith, of Glenbarr	1842
1630	Macallan, James, W.S.	1823
	Macarthur, Major Alexander	1840
	Macarthur, Duncan, Dunollybeg, Oban	1842
	Macarthur, Dr Peter, Australia	1819
	Macaskill, Donald, of Rhudunan	1840
	Macaskill, Hugh	1830
	M'Auslin, J., Kilbridbeg, Cairndow	1853
	Macbean, Duncan, of Tomatin, Merchant, Glasgow	1828
	Macbean, Æneas, W.S.	1812
	Macbean, Lieut.-Colonel James	1806
1640	M'Bryde, John, Balkerr, Stranraer	1851
	M'Call, Henry, younger of Daldowie	1846
	M'Call, James, of Daldowie	1844
	M'Call, Samuel, of Caitloch, Minniehive	1847
	M'Call, Thomas, Merchant, Glasgow	1838
	M'Callum, George Kellie, of Reddoch	1842
	M'Callum, John, Plewlands, Edinburgh	1843
	M'Caw, Alexander, Ardlochan, Maybole	1851
	M'Clean, Alexander H., Auchneed, Stranraer	1851
	MacCheyne, Adam, W.S.	1819
1650	MacClelland, George, W.S.	1838
	M'Coll, Donald, Appin House	1843
	M'Combie, James Boyn, of Gillybrands, Aberdeen	1840
	M'Combie, William, of Lynturk and Easter Skene	1840
	M'Combie, William, Tillyfour, Aberdeen	1847
	M'Conochie, John, Mains of Penninghame, Newton-Stewart	1851
	MacConnell, Archibald, Merchant, Glasgow	1845
	MacConnell, John, Penrith	1842
	M'Craken, John, Drum, Dumfries	1850
	M'Culloch, David, Auchness, Stranraer	1852

		Admitted
1660	M'Culloch, Walter, of Kirkclaugh, Gatehouse	1849
	Macdonald, Alaster M'Ian, younger of Dalchosnie	1841
	Macdonald, Alexander, of Lochshiel	1824
	Macdonald, Major-General Alexander	1810
	Macdonald, Dr Alexander, Prince Edward's Island	1838
	Macdonald, Alexander, Inverness	1841
	Macdonald, Alexander, Broadford, Skye	1840
	Macdonald, Captain Angus, of Milltown	1798
	Macdonald, Angus, of Glenaladale	1827
	Macdonald, Archibald, Islay	1838
1670	Macdonald, Major Donald, of Ardmore	1822
	Macdonald, Donald, Bridge End, Dingwall	1850
	Macdonald, Captain Donald, of Isauld	1817
	Macdonald, Donald, of Craigrue	1829
	Macdonald, Donald, Lochinver, Bonar Bridge	1834
	Macdonald, Duncan George Forbes, C.E., Dingwall	1850
	Macdonald, Hugh P., Gourock, Portree	1830
	Macdonald, James Thomas, of Balranald	1832
	Macdonald, Major-General John, of Dalchosnie	1819
	Macdonald, John, Procurator-Fiscal, Dunfermline	1836
1680	Macdonald, John Robertson, Rodil, Harris	1841
	Macdonald, Ranald, of Bornish	1806
	Macdonald, Reginald George, of Clanranald	1807
	Macdonald, Lieut.-Col. Robert, of Inchkenneth, C.B.	1814
	Macdonald, Roderick C., of Castle Teirim	1839
	Macdonald, Thomas, Fort-William	1827
	Macdonald, Lieut.-Colonel William, of Powderhall	1813
	Macdonald, Professor William, M.D., St Andrews	1818
	Macdonald, William, Glasgow	1844
	Macdonald, William Bell, of Rammerscales	1841
1690	Macdonald, Wm. Macdonald, of St Martins and Garth	1844
	Macdonell, Æneas Ronald, Try House, Arisaig	1846
	Macdouall, Lieut.-Colonel James, of Logan, 2d Life Guards	1838
	Macdougal, Colin, of Lunga	1808
	Macdougal, Captain James Patrick	1838
	Macdougal, Major Patrick, of Soroba	1800
	Macdougall, Alexander, Granton Farm, Edinburgh	1847
	Macdougall, Allan, W.S.	1829
	M'Dougall, Dugald, of Gallanach	1814
	Macdougall, John, of Macdougall, Captain R.N.	1821
1700	M'Dougall, Patrick, younger of Gallanach, W.S.	1849
	Macdowall, Colonel Day Hort, of Garthland	1846
	Macdowall, Henry, Carruth, Renfrewshire	1845

		Admitted
	Macduff, Alexander, of Bonhard	1843
	Macduff, Captain Alex., Factor for the Duke of Atholl	1839
	Maceachern, Captain Colin, of Oatfield	1825
	M'Ewan, Alexander, of Sunderland	1846
	Macewan, James, of Tar of Ruskie	1834
	M'Ewan, John, Merchant, Inverness	1839
	MacEwan, John, Merchant, Glasgow	1850
1710	MacEwan, Peter, Blackdub, Stirling	1851
	Macfarlan, William, of Bencloich	1832
	Macfarlane, Alexander, of Thornhill	1825
	Macfarlane, John, of Muckroy	1821
	Macfarlane, John Fletcher, Surgeon, Edinburgh	1823
	Macfarlane, Thomas, Clachan, Strachur	1829
	M'Farlane, James, of Balwill	1851
	M'Farlane, John, Faslane, Helensburgh	1851
	Macfie, William, younger of Langhouse, Greenock	1826
	M'Gill, James, Torrorie, Kirkbean	1850
1720	M'Gill, John, Barsalloch, Wigtown	1850
	Macgillivray, William, Dunnygask, Dunfermline	1847
	Macgregor, Alexander, London	1837
	Macgregor, Alexander, jun., Glasgow	1823
	Macgregor, Lieut.-Colonel Hugh, Portobello	1814
	Macgregor, James, Fort-William	1833
	Macgregor, John, of Glengyle	1832
	Macgregor, Lieut.-General Murray	1801
	Macgregor, Robert, Delavorar, Ballindalloch	1839
	Machray, Isaac, Torry Farm, Aberdeen	1841
1730	M'Ilraith, James, of Auchenflower	1835
	Macinroy, James Patrick, of Lude	1831
	Macinroy, Major William, of The Burn	1827
	Macintosh, Major-General, of Campsie	1852
	Macintyre, John, Cleugh Farm, Oban	1844
	Macivor, John, New South Wales	1827
	M'Iver, Evander, Factor for the Duke of Sutherland, Scourie	1850
	Mack, James, Upper-Keith, Blackshiels	1851
	Mackay, Charles, Jeweller, Edinburgh	1839
	Mackay, Donald, Lythmore, Thurso	1852
1740	Mackay, George, of Bighouse	1846
	Mackay, James, Edinburgh, Silversmith to the Society	1804
	Mackay, John, Banker, Inverness	1837
	Mackay, Thomas George, W.S.	1837
	Mackellar, Duncan, Edinburgh	1839
	Mackenzie, Alex., Allanfiarn, Culloden, Inverness	1853

		Admitted
	Mackenzie, Alexander, younger of Muirton	1846
	Mackenzie, Daniel, jun., Merchant, Glasgow	1844
	Mackenzie, Donald, Advocate	1848
	Mackenzie, George Dingwall	1830
1750	Mackenzie, James, W.S.	1845
	Mackenzie, James William, Banff	1825
	Mackenzie, John, of Glack	1835
	Mackenzie, John, Ness House, Inverness	1809
	Mackenzie, John, Manager, Scottish Widows' Fund, Edinburgh	1848
	Mackenzie, John Ord, of Dolphinton, W.S.	1848
	Mackenzie, John Whitefoord, W.S.	1821
	Mackenzie, John, Inchvannie, Dingwall	1850
	Mackenzie, John, Burnhill, Dumfries	1850
	Mackenzie, Keith William Stewart, of Seaforth	1846
1760	Mackenzie, Kenneth, Accountant, Edinburgh	1848
	Mackenzie, Kenneth Francis, Edinburgh	1811
	Mackenzie, Kenneth John, younger of Applecross, Advocate	1845
	Mackenzie, Murdo, Dundonnell	1799
	Mackenzie, Robert Duncanson, of Caldarvan	1838
	Mackenzie, Sutherland, Edinburgh	1808
	Mackenzie, Captain, 92d Highlanders	1845
	Mackenzie, Thomas, of Ord	1846
	Mackenzie, Thomas, of Applecross	1816
	Mackenzie, Thomas, Advocate, Sheriff of Ross and Cromarty	1851
1770	Mackenzie, Thomas, Architect, Elgin	1853
	Mackenzie, Dr William, of Culbo, Edinburgh	1810
	Mackenzie, William, of Muirton, W.S.	1803
	Mackenzie, William Forbes, of Portmore, M.P.	1831
	Mackenzie, Wm., yr. of Cornhill, Perth	1852
	Mackerrel, Henry, of Hillhouse	1837
	Mackie, James, younger of Bargaly	1845
	Mackie, John, of Bargaly, M.P.	1844
	Mackie, John Wyse, Princes Street, Edinburgh	1852
	Mackinlay, David, Oswald Bank, Partick	1844
1780	Mackinlay, David, of Newlandburn	1848
	Mackinlay, John, Whitehaven	1818
	Mackinnon, Alexander Kenneth, Corry, Broadford	1827
	Mackinnon, Rev. John, Slate	1815
	Mackinnon, Neil, of Demerara	1829
	Mackinnon, William Alexander, of Mackinnon, M.P.	1811
	Mackintosh, Æneas, of Daviot	1839
	Mackintosh, Æneas W., of Raigmore	1844

		Admitted
	Mackintosh, Alexander, of Mackintosh	1833
	Mackintosh, Colonel Alexander, of Farr	1839
1790	Mackintosh, Angus, of Holm	1844
	Mackintosh, Charles, of Aberarder	1831
	Mackintosh, Eneas, of Balnespick	1846
	Mackintosh, George, of Geddes	1832
	Mackintosh, George Gordon, Balnespick	1846
	Mackintosh, James, of La Mancha	1851
	Mackintosh, John, Auchancloich, Nairn	1849
	Mackintosh, John, Manufacturer, Inverness	1839
	Mackintosh, William, Australia	1813
	M'Knight, Robert, of Barlochan	1840
1800	M'Kirdy, John Gregory, of Birkwood	1850
	Maclachlan, Alexander, Easter Longhaugh, Paisley	1850
	Maclachlan, Colin, Laudle, Strontian	1836
	Maclachlan, Dugald, Fort-William	1832
	Maclachlan, Dugald, Killimore	1838
	Maclachlan, Eun, Liddisdale, Strontian	1836
	Maclachlan, George, W.S.	1843
	Maclachlan, Robert, of Maclachlan	1817
	Maclagan, Peter, Factor, Invercald, Braemar	1847
	Maclagan, Peter, yr. of Pumpherston, Mid-Calder	1847
1810	Maclaine, Hugh, of Killundine	1847
	Maclaren, Charles, Edinburgh	1833
	Maclaren, Donald, of Dullatur, Callander	1832
	Maclaren, Duncan, Cambuserricht	1834
	Maclaren, John, of Balemenoch	1839
	Maclaren, William, Glasgow	1850
	Maclaren, Major, Portobello	1844
	Maclean, Colonel Alexander, of Ardgower	1793
	Maclean, Alexander, of Carsaig	1835
	Maclean, Col. Allan Thomas	1835
1820	Maclean, Archibald D., London	1837
	Maclean, Colin, of Laggan, Islay	1838
	Maclean, Donald, of Boreray	1822
	Maclean, Donald, of Kinloch, W.S.	1793
	Maclean, George, Ardnacroish, Mull	1849
	Maclean, Hugh, of Coll	1819
	Maclean, Hugh, Brighton	1827
	Maclean, James, Braidwood, Penicuik	1841
	Maclean, Dr Lachlan, Tobermory	1823
	Maclean, Neil, Land-Surveyor, Inverness	1837
1830	Maclean, Patrick, of Hawkhill, Fortrose	1845
	Maclean, Thomas, Grain and Seed Merchant, Edinburgh	1853

		Admitted
	Maclean, William, of Plantation, Glasgow	1838
	Maclean, Captain William, R.N., Ardgower	1840
	Macleay, Alexander D., Bilbster, Wick	1846
	Macleay, Kenneth, of Newmore	1839
	Maclennan, John	1840
	Macleod, Alexander, Surgeon, Uist	1829
	Macleod, Alexander, of Canada	1811
	Macleod, Alexander Norman	1817
1840	Macleod, Donald, Claggan, Dunvegan	1841
	Macleod, Donald, Gledfield	1830
	Macleod, John N., Factor, Craufurd Priory, Cupar	1849
	Macleod, Norman, of Macleod	1839
	Macleod, Mrs, senior, of Macleod	1816
	Macleod, Norman, of Dalvey	1839
	Macleod, Martin, of Drynoch	1831
	Macleod, Roderick, of Cadboll	1807
	Macleod, Colonel William	1817
	Macmillan, Donald, of Lephenstrath	1825
1850	Macmillan, Captain Iver	1798
	Macmillan, James, of Lamloch	1834
	M'Murrich, James, of Stuckgown	1852
	Macnab, Archibald, of Macnab	1806
	Macnab, James Monro	1837
	M'Nab, Kennedy, Millburn Cottage, Inverness	1853
	M'Nab, Thomas, Redburn, Irvine, Secretary, Ardrossan Farmers' Club	1853
	Macnair, James, of Auchineck, Largs	1838
	Macneale, George, of Ugadale	1825
	Macneale, Hector, yr. of Ugadale	1848
1860	M'Neill, Archibald, W.S., Edinburgh	1846
	M'Neill, Malcolm Macmillan, younger of Carskey	1839
	Macneill, Alexander, Advocate	1835
	Macneill, John, of Ardnacross	1847
	Macneill, Major-General Roderick, Barra	1817
	Macnicol, Lieut. Nicol, Dunans	1836
	M'Nicoll, John, Craig, Alyth, Factor for the Earl of Airlie	1831
	Maconochie, Alexander, of Meadowbank, Treasurer of the Society	1800
	Maconochie, Allan, younger of Meadowbank	1842
	Maconochie, Robert Blair, W.S.	1852
1870	Macpherson, Lieut. Alexander, Ruthven, Kingussie	1839
	Macpherson, Alexander, M.D., Garbity	1841
	Macpherson, Allen, London	1822
	Macpherson, Colonel D., Burcie House, Forres	1839

		Admitted
	Macpherson, Major-General Duncan, Cheltenham	1825
	Macpherson, Major Duncan, Inverness	1839
	Macpherson, Ewen, of Cluny-Macpherson	1827
	Macpherson, George, Factor for the Duke of Richmond, Gibston, Huntly	1850
	Macpherson, Hugh, Blantyre Farm, Glasgow	1850
	Macpherson, Hugh, of Eigg, M.D., one of the Professors of King's College, Aberdeen	1828
1880	Macpherson, Kenneth	1826
	Macpherson, Captain Lachlan, Ballidmore, Kingussie	1839
	Macpherson, William, of Blairgowrie	1822
	Macqueen, Robert, of Braxfield	1842
	Macqueen, Captain Simon, Corrybrough	1820
	Macrae, Alexander, Askernish, Carinish	1832
	Macrae, Archibald, M.D., Bruiach, Beauly	1839
	Macrae, Colin, of Demerara	1823
	Macrae, Donald, Luskintyre, Harris	1850
	Macrae, Rev. Finlay, North Uist	1841
1890	Macredie, Patrick Boyle Mure, of Perceton	1830
	Macritchie, Charles Elder, Edinburgh	1831
	Macritchie, John, Whitburgh, Ford	1846
	Macritchie, Thomas Elder, of Craigton, W.S.	1831
	Mactaggart, Captain J. O., of Seafield	1835
	Mactavish, Alexander, Solicitor, Inverness	1839
	MacTier, Alexander Walker, younger of Durris	1848
	MacTier, Anthony, of Durris	1834
	Macturk, Robert, of Hastingshall	1826
	Macvicar, John, of Ardarroch	1842
1900	Macvicar, Rev. J. G., D.D., Ceylon	1828
	Macwilliam, Alexander, Bucharn, Huntly	1850
	Macwilliam, George, Land-Surveyor and Farmer, Sheriffston, Elgin	1841
	M'William, Robert, Tartury, Rothiemay	1852
	Madden, Henry R., M.D., Brighton	1839
	Main, Alexander, Factor, Dalhousie, Mid-Lothian	1849
	Main, Alexander James, Factor, Whitehill, Lasswade	1847
	Maitland, George F., of Hermand	1852
	Maitland, Steuart, of Dundrennan	1852
	Makellar, Rev. Angus, D.D., Edinburgh	1818
1910	Makgill, George, of Kemback	1841
	Makins, Edward, Auchincrow Mains, Ayton	1841
	Malcolm, Neill, of Poltalloch	1830
	Malcolm, William E., of Burnfoot	1840
	Mann, John, Glasgow	1847

		Admitted
	Mansfield, Thomas, Accountant, Edinburgh	1827
	Manson, David D., Spynie, Elgin	1853
	Marshall, Claud, Greenock, Sheriff-Substitute of Renfrewshire	1819
	Marshall, James, Jeweller, Edinburgh	1833
	Marshall, John, Achinduich, Sutherland	1847
1920	Marshall, Robert, Gateside, Kirkliston	1850
	Marshall, Walter, Jeweller, Edinburgh	1839
	Marshall, Captain William, Rothesay	1845
	Marshall, William, Goldsmith, Edinburgh	1843
	Martin, George, Civil Engineer, Glasgow	1839
	Martin, James Watson, Old Saughton, Slateford	1850
	Martin, William, Kilchoan, Lochgilphead, Factor for Neill Malcolm, Esq., of Poltalloch	1844
	Martin, William, Secretary, Renfrewshire Agricultural Society, Paisley	1846
	Matheson, Alexander, of Ardross, M.P.	1846
	Mather, Arthur, Nether Place, Newton	1850
1930	Matheson, Lieut.-Colonel Thomas	1847
	Mathews, Niven, Whitehills, Garliestown	1853
	Maxton, James, of Cultoquhey	1848
	Maxton, John, Wine-Merchant, Leith	1835
	Maxwell, Alexander Harley, of Portrack	1834
	Maxwell, Francis, of Breoch	1841
	Maxwell, Francis	1844
	Maxwell, Henry Constable, of Milnehead	1838
	Maxwell, John Argyll	1834
	Maxwell, John Hall, of Dargavel, Secretary of the Society	1833
1940	Maxwell, Lieut.-Colonel, of Orchardton and Gretna	1825
	Maxwell, Marmaduke C., of Terregles	1830
	Maxwell, Wellwood, of The Grove	1838
	Maxwell, Wellwood, of Munches	1839
	Maxwell, William, younger of Cardoness	1841
	Maxwell, William, of Carruchan, Chamberlain to the Duke of Buccleuch and Queensberry	1837
	Maxwell, Wm. Constable, of Nithsdale and Evringham	1830
	May, George, Civil Engineer, Superintendent of the Caledonian Canal	1839
	Mayne, Robert, Melville Street, Edinburgh	1838
	Meall, James, Buttergask, Cupar-Angus	1852
1950	Meason, Magnus Gilbert Laing, of Ballinshoe	1836
	Mechi, John Joseph, of Tiptree Hall, Essex	1845
	Meek, George, of Campfield	1814
	Megget, Thomas, W.S.	1811

		Admitted
	Meiklam, James, of Cairnbroe	1831
	Meiklejohn, Rev. Robert, Strathdon	1840
	Mein, Robert, Factor to the Duke of Bedford	1838
	Meldrum, Alexander, of Easter Kincaple	1841
	Melrose, Andrew, Merchant, Pendreich	1845
	Melville, James Moncrieff, of Hanley, W.S.	1848
1960	Melville, John Whyte, of Mount Melville	1819
	Melvin, James, Bonnington, Ratho	1849
	Menzies, Major Archibald, Edinburgh	1817
	Menzies, Fletcher Norton, Castle Menzies	1841
	Menzies, James Alexander Robertson, Surgeon, Annat	1849
	Menzies, John, of Chesthill	1821
	Menzies, Ranald, of Culdares	1842
	Menzies, Robert, Land-Surveyor, Dunkeld	1829
	Mercer, George, of Gorthy	1822
	Mercer, Græme, younger of Gorthy	1850
1970	Mercer, James, M.D., York	1844
	Merricks, James, Gunpowder Manufacturer, Roslin	1841
	Merry, James, Glasgow	1838
	Middleton, Charles Stuart, Merchant, Liverpool	1840
	Mill, James, Surgeon, Thurso	1839
	Millar, C. H., Merchant, Montrose	1853
	Millar, James Lawson, Waulkmill, Dunfermline	1852
	Millar, John, South St Andrew Street, Edinburgh	1848
	Miller, Captain Alexander Penrose	1843
	Miller, George, of Frankfield	1814
1980	Miller, John, of Leithen, Civil Engineer, Edinburgh	1847
	Miller, O. G., Writer, Dundee	1843
	Milne, Alexander, of Gartferry	1844
	Milne, Alexander, Mains of Eslemont, Ellon	1851
	Milne, George, of Kinaldie	1851
	Milne, George, Haddo, Methlic	1851
	Milne, Nicol, of Faldonside	1841
	Milne, William, Mains of Waterton, Ellon	1851
	Mitchell, Alexander, of Sauchrie	1851
	Mitchell, Andrew, Alloa	1848
1990	Mitchell, George, Auchnagathle, Whitehouse, Aberdeenshire	1852
	Mitchell, Houston, of Polmood	1848
	Mitchell, James, Little Knox, Castle-Douglas	1851
	Mitchell, John, Ballemenach, Campbeltown	1850
	Mitchell, John M., Merchant, Leith	1832
	Mitchell, John, Inverscaddle, Ardgour	1843
	Mitchell, Joseph, Civil Engineer, Inverness	1836
	Mitchell, Robert, Cadham, Markinch	1852

		Admitted
	Mitchell, Thomas, Newhouse, Selkirk	1853
	Mitchell, Samuel, Strath, Campbeltown	1850
2000	Mitchell, William Gillespie, of Carwood	1849
	Mitchelson, Arch. Hepburne, Old Faskally	1832
	Moffat, James, Garwald, Langholm	1850
	Moffat, John, Craick, Hawick	1850
	Moffat, Wm. Craigbeck, Moffat	1851
	Moir, Benjamin, Merchant, Aberdeen	1840
	Moir, John Macarthur, of Hillfoot and Milton	1834
	Moir, Robert, Tarty, Ellon	1851
	Moir, Robert Graham, of Leckie	1850
	Moncreiff, James, M.P., Lord Advocate for Scotland	1848
2010	Moncrieff, Alexander, W.S., Perth	1842
	Moncrieff, George, Writer, Perth	1852
	Moncrieff, Robert Scott, of Fossaway	1831
	Monro, Dr Alexander, of Craiglockhart	1807
	Monro, Alexander, younger of Craiglockhart	1835
	Monro, Alexander Binning, of Auchinbowie	1833
	Monro, David, of Allan, Tain	1851
	Monteath, Alex. Earle, Advocate, Sheriff of Fifeshire	1848
	Monteath, Brydon, Nether Liberton, Edinburgh	1846
	Monteath, James, of Monkridden Mains	1845
2020	Monteath, John, younger of Monkridden Mains	1845
	Monteath, Robert, of Carstairs	1837
	Montgomerie, Rear-Admiral Alexander	1834
	Montgomery, John H., of Newton	1846
	Montgomery, Robert, Edinburgh	1829
	Moore, James Carrick, of Corsewall	1829
	Moore, John Carrick, younger of Corsewall	1839
	More, John Schank, Advocate, Professor of Scots Law, University of Edinburgh	1816
	Morgan, James, S.S.C.	1841
	Morison, Alexander, of Bognie and Mountblairy	1840
2030	Morison, Andrew, Inchmichael, Errol	1852
	Morison, James G., Glasgow	1850
	Morrieson, Robert, Edinburgh	1833
	Morris, William Pollok, of Craig	1833
	Morrison, Alexander, of Balinakeil, Writer, Glasgow	1838
	Morrison, A. G., Salachan, Ardgour	1843
	Morrison, James, younger of Balinakeil, Glasgow	1850
	Morton, Hugh, Engineer, Edinburgh	1835
	Morton, Hugh, Writer, Glasgow	1844
	Morton, John Lockhart, Land Agent, Edinburgh	1852
2040	Mosman, Captain Hugh, of Auchtyfardle	1850

		Admitted
	Mouat, Captain William Cameron, of Garth	1838
	Moubray, John Marshall, of Hartwood, W.S.	1843
	Mudie, John, of Pitmuies, Advocate	1840
	Muir, George W., Caberston, Innerleithen	1852
	Muir, James, Barone Park, Rothesay	1849
	Muir, John, of Gartferry	1843
	Muirhead, Claud, Publisher of the Edin. Advertiser	1820
	Muirhead, James, Jeweller, Glasgow	1844
	Munro, Captain Hugh, Coul Cottage, Alness	1799
2050	Munro, Hugh Andrew Johnston, of Novar	1832
	Munro, Thomas M. Scott, of Benrig	1843
	Murdoch, John Burn, of Gartincaber	1820
	Murdoch, John Burn, junior, Advocate	1853
	Murdoch, Peter, Newton	1839
	Mure, David, Advocate	1847
	Mure, James O. Lockhart, of Livingstone	1828
	Mure, Colonel William, of Caldwell, M.P., Vice-Lieutenant of Renfrewshire	1840
	Mure, William, Factor to the Earl of Selkirk	1841
	Murray, Andrew, of Conland	1846
2060	Murray, Anthony, of Dollorie, W.S.	1828
	Murray, Jack W., Captain R.N.	1843
	Murray, James, of the Monkland Iron-Works	1828
	Murray, James, of Craigend, Drochil Castle, Peebles	1840
	Murray, James, East Barns, Dunbar	1850
	Murray, James, Auchterellon, Ellon	1851
	Murray, James Thomas, W.S.	1840
	Murray, John Dalrymple, of Murraythwaite	1825
	Murray, John, of Polmaise	1840
	Murray, John, of Murrayshall, Advocate	1842
2070	Murray, John Nisbet, younger of Philiphaugh	1846
	Murray, Joseph, of Ayton	1820
	Murray, Patrick, of Simprim	1794
	Murray, Kenneth, Banker, Tain	1851
	Murray, Captain Samuel Hood	1834
	Murray, Robert, Spittal, Penicuik	1850
	Murray, Sutherland, Geanies, Tain	1851
	Murray, Thomas Graham, W.S.	1852
	Murray, William, Monkland House	1827
	Murray, William, of Henderland	1826
2080	Murray, William Hugh, of Geanies, Advocate	1846
	Mustard, James, Leuchland, Brechin	1850
	Mutrie, David, Merchant, Glasgow	1804
	Mylne, Thomas, Niddrie Mains, Liberton	1850
	Mylne, William, Bolton, Haddington	1841

		Admitted
	NORTHESK, The Right Hon. William, Earl of	1843
	NAPIER, The Right Hon. Francis, Lord	1843
	NAPIER, Sir Robert Milliken, of Milliken, Bart.	1848
	NICHOLSON, Sir Arthur, of Nicholson, Bart.	1812
	Nairn, David	1826
2090	Nairne, John Mellis, of Dunsinnan	1852
	Naismith, Alexander, Windlestrawlee, Edinburgh	1852
	Napier, George, Advocate, Sheriff of Peeblesshire	1840
	Napier, Robert	1844
	Nasmyth, Robert, Edinburgh	1839
	Neaves, Charles, Advocate	1846
	Neilson, James Beaumont, of Queenshill	1851
	Newall, James, Banker, Newton-Stewart	1845
	Newall, John, Cassencarrie, Creetown	1845
	Newbigging, John Stewart, Jedburgh	1836
2100	Newton, James, of Castlandhill, W.S.	1846
	Newton, James Ewan, of Whitecroft, Ecclefechan	1838
	Newton, Robert Pillans, Factor for the Earl of Zetland	1837
	Nicol, James, Advocate, Aberdeen	1840
	Nicoll, Alexander	1844
	Nicolson, Major Allan Macdonald, of Ardmor	1819
	Nicolson, John Archibald Stewart, of Carnock	1853
	Nielson, Andrew, Bank of Scotland, Glasgow	1843
	Nimmo, James, Sight Hill, Corstorphine	1847
	Nimmo, Matthew, Foot of Green, Stirling	1852
2110	Nisbett, John More, of Cairnhill	1847
	Nivison, Thomas, Burn, Thornhill	1852
	Noble, John, London	1838
	Noble, William, London	1838
	OGILVY, The Honourable William, of Loyal	1823
	OGILVY, The Honourable Donald, of Clova	1824
	OGILVY, Sir John, of Inverquharity, Bart.	1824
	ORDE, Sir John Poullet, of Kilmory, Bart.	1830
	Ogden, John Biss, Berryhill, Coldstream	1841
	Ogilvie, Captain William, R.N.	1820
2120	Ogilvie, William, of Chesters	1809
	Ogilvy, Charles, Broomknow, Brechin	1850
	Ogilvy, John, of Inshewan	1836
	Ogilvy, Peter Wedderburn, of Ruthven	1826
	Ogilvy, Thomas, younger of Ruthven	1844
	Ogilvy, Thomas, of Corrimony	1838
	Ogston, Alexander, of Ardo	1840

		Admitted
	Oliphant, Charles, W.S.	1813
	Oliphant, Laurence, of Condie	1828
	Oliphant, Robert, of Rossie	1840
2130	Oliver, James, Burnfoot, Langholm	1850
	Oliver, James, Secretary, West Teviotdale Agricultural Society, Hawick	1852
	Oliver, Robert Stephen, Merchant, Edinburgh	1842
	Ord, John, of Muirhouselaw	1841
	Ormiston, William Thomas, of Glenburnhall	1848
	Orr, Andrew, of Glenfield	1844
	Oswald, Alexander, of Auchencruive	1845
	Oswald, James, of Auchencruive	1829
	Oswald, J. Townshend, of Dunikier	1848
	Ovens, Thomas, Merchant, Galashiels	1851
2140	†Polwarth, The Right Hon. Henry Francis H., Lord	1829
	Panmure, The Right Hon. Fox, Lord	1831
	Pollok, Sir Hew Crawford, of Pollok, Bart.	1846
	Pringle, Sir John, of Stitchell, Bart.	1810
	Parish, Sir Woodbine	1819
	Pagan, Allan Cunningham, Holestane, Thornhill	1852
	Pagan, Samuel A., M.D., Edinburgh	1848
	Pagan, William, Banker, Cupar-Fife	1845
	Pape, George, of Colt Bridge House, Edinburgh	1848
	Park, George, of Skedsbush	1852
2150	Park, William, of Blegbie, Birkenside, Earlestone	1849
	Parkes, Samuel, London	1817
	Paterson, Alexander, Wine-Merchant, Leith	1840
	Paterson, Alexander, Mains of Mulben, Keith	1853
	Paterson, Archibald, Meadowfield, Corstorphine	1848
	Paterson, Campbell, Knock, Mull	1844
	Paterson, George, of Castle Huntly	1841
	Paterson, Henry, Portobello	1839
	Paterson, John, West Hopes, Dalkeith	1850
	Paterson, John, East Preston, Kirkbean	1850
2160	Paterson, John, Skinnet, Thurso	1832
	Paterson, John, junior, Killeonan, Campbeltown	1847
	Paterson, John, Macoriston, Doune	1852
	Paterson, Peter Hay, of Carpow	1849
	Paterson, Robert, of Birthwood	1848
	Paterson, Robert, of Brocklehirst	1835
	Paterson, Walter, Merchant, Glasgow	1851
	Paterson, William, Twiglees, Lockerby	1851
	Patison, John, W.S.	1806

		Admitted
	Paton, John, of Crailing	1833
2170	Paton, John, of Grandholm	1841
	Patrick, William, of Roughwood, W.S.	1805
	Patterson, William, of Cunnoquhie	1847
	Patterson, John, Westerton of Cowie, Stirling	1850
	Patterson, Robert, Offers, Stirling	1851
	Patton, George, of Cairnies, Advocate	1843
	Patton, James Murray, of Glenalmond	1830
	Paul, Henry, Edinburgh	1830
	Paul, Rev. John, D.D., Edinburgh	1839
	Pearson, Alexander, W.S.	1819
2180	Peddie, William, of Blackruthven, Perth	1828
	Pender, James B.	1848
	Pender, Thomas	1839
	Pender, William, Condorat, Dumbarton	1852
	Penny, William, Advocate	1844
	Peter, John, Dundee	1828
	Peter, Robert, Banker, Aberfeldy	1849
	Philip, Robert, Merchant, Leith	1844
	Philip, John, Polton Mains, Lasswade	1851
	Philp, John, Edinburgh	1828
2190	Pillans, James, Edinburgh	1799
	Piper, Edward, Edinburgh	1833
	Piper, John, Edinburgh	1848
	Pitcairn, John, of Pratis	1841
	Pittendrich, Wm., Mains of Frendraught, Forgue	1852
	Playfair, William Henry, Architect, Edinburgh	1824
	Plummer, Charles Scott, of Sunderlandhall	1842
	Plummer, George Hay, Melville, Dalkeith	1850
	Pollexfen, James R., of Cairston, W.S.	1841
	Pollock, Arthur, Merchant, Grangemouth	1815
2200	Pollock, John, Merchant, Glasgow	1838
	Pollok, Allan, younger of Faside	1844
	Ponton, George, Grougfoot, Linlithgow	1852
	Popham, Strachan Irvine, Ardchattan Priory, Bonaw	1843
	Porteous, Alexander, of Lauriston	1851
	Porteous, Robert, Milton, Lesmahagow	1850
	Porterfield, J. C., of Porterfield	1850
	Pott, George, of Todrig	1848
	Powrie, James, of Reswallie	1849
	Pringle, Alexander, of Whytbank, Vice-Lieutenant of Selkirkshire	1821
2210	Pringle, Rear-Admiral James, of Torwoodlee	1820
	Pringle, Robert K., of Broadmeadows	1852

		Admitted
	Proctor, William D., Glammis, *Factor for the Earl of Strathmore*	1829
	Proudfoot, John, Inveresk, Musselburgh	1848
	Pugh, William, Coalport, Ironbridge	1847
	Purves, James, Thurdistoft, Thurso	1839
	Purves, John, younger of Kinaldie	1844
	Purves, William, Burnfoot, Jedburgh	1851
	†QUEENSBERRY, The Most Noble John, Marquis of	1825
	*RICHMOND and LENNOX, His Grace Charles, Duke of, K.G.	1836
2220	*ROXBURGHE, His Grace James Henry Robert, Duke of, K.T.	1837
	†ROSEBERY, The Right Hon. Arch. Jn., Earl of, K.T.	1806
	†ROSSLYN, The Right Hon. James Alexander, Earl of	1835
	RANFURLY, The Right Hon. Thomas, Earl of	1838
	REIDHAVEN, The Right Hon. John Charles, Viscount	1842
	RUTHVEN, The Right Hon. James, Lord	1810
	ROSSMORE, The Right Hon. Henry Robert, Lord	1850
	RUTHERFURD, The Right Hon. Lord	1845
	ROBERTSON, The Honourable Lord	1816
	RICHARDSON, Sir John Stewart of Pitfour, Bart.	1823
2230	RAMSAY, Sir James, of Bamff, Bart.	1823
	RIDDELL, Sir James Milles, of Arnamurchan and Sunart, Bart.	1808
	RADCLIFFE, Sir Joseph, of Millsbridge, Bart., Yorkshire	1820
	RUSSELL, Lieut.-Gen. Sir J., of Ashiesteil, K.C.B.	1823
	Rainy, George, of Rasay	1846
	Rait, D. C., Goldsmith, Glasgow	1838
	Ralston, Robert William, younger of Glenelrig	1840
	Ramsay, Alexander, of Demerara	1806
	Ramsay, Captain Thomas, Banchory Lodge	1828
	Ramsay, Robert Balfour Wardlaw, of Whitehill	1841
2240	Ramsay, Professor William, Glasgow	1844
	Ramsay, William Burnett, of Banchory Lodge	1841
	Ramsay, Thomas, Derwent Haugh, Newcastle-on-Tyne	1851
	Ranken, Bryce Macmurdo, Proc.-Fisc. of Orkney	1841
	Ranken, George, Australia	1839
	Ranken, Patrick, of Mavisbank	1844
	Ranken, Thomas, S.S.C.	1838
	Ranken, William, M.D., Glenlogan	1836

		Admitted
	Rannie, Robert Walker, Inchira, Perth	1827
	Rashleigh, William, of Monabilly	1837
2250	Rate, John, Milton, West Salton	1852
	Rattray, Thomas, younger of Brewlands	1834
	Reed, Ellerington, Kilcolmkill, Golspie	1847
	Reed, Robert, Sidera, Golspie	1847
	Reid, Charles G., of Grangehill, W.S.	1844
	Reid, George, Ballencrieff, Haddington	1847
	Reid, James, Muirton, Belhelvie	1852
	Reid, Walter, Drem, Haddington	1850
	Rennie, Archibald Hill, of Balliliesk	1839
	Rennie, William, Banker, Maybole	1836
2260	Renton, James, Accountant	1841
	Renton, John Campbell, of Lamberton	1839
	Rhind, Josiah, Banker, Wick	1839
	Rhind, David, Architect, Edinburgh	1852
	Rhind, Macduff, Advocate, Sheriff-Substitute of Wigtownshire	1843
	Richardson, Francis, Merchant, Edinburgh	1849
	Richardson, James, Merchant, Edinburgh	1833
	Richardson, James, of Ralston	1850
	Richardson, John, Writer, Haddington	1851
	Richardson, Ralph, Merchant, Edinburgh	1828
2270	Richardson, Robert, Merchant, Edinburgh	1837
	Richardson, Lieut.-Col. Rob. Robertson, of Tullybelton	1847
	Richardson, William, Banker, Lockerbie	1843
	Rickman, Thomas, Architect, Birmingham	1831
	Riddell, Campbell D., Australia	1816
	Riddell, John, Advocate	1817
	Riddell, Thomas Milles, younger of Ardnamurchan and Sunart	1845
	Riddell, Lieut.-General	1849
	Riddell, Wm., Hundalee, Jedburgh	1852
	Rigg, James Home, of Tarvit	1824
2280	Rintoul, Charles, East Craigie, Cramond	1852
	Ritchie, Robert, Civil Engineer, Edinburgh	1833
	Ritchie, Thomas, Bowhouse Farm, Alloa	1838
	Ritchie, William, of Middleton	1848
	Ritchie, William, Plean Mill, Stirling	1852
	Robb, James, Gorgie, Slateford	1849
	Roberton, James, Ladyrig, Kelso	1841
	Roberton, William, of Lauchope	1844
	Robertson, Alexander, W.S.	1825
	Robertson, Alexander, Woodside, Elgin	1842
2290	Robertson, Alexander Inglis, yr. of Aultnaskiach	1839

		Admitted
	Robertson, Andrew, Balmoral	1832
	Robertson, Arthur John, of Inches	1840
	Robertson, Charles, Buttergask, Perth	1836
	Robertson, Charles Gordon, Advocate, Stonehaven, Sheriff-Substitute of Kincardineshire	1842
	Robertson, David, of Ladykirk	1842
	Robertson, David, Aberdeen	1847
	Robertson, George, Edinburgh	1819
	Robertson, Captain George A.	1817
	Robertson, George Duncan, of Strowan	1839
2300	Robertson, Henry, of Borland	1832
	Robertson, James, Chamberlain to the Duke of Argyll, at Inveraray	1836
	Robertson, James Saunders, W.S.	1816
	Robertson, James Stewart, of Edradynate	1811
	Robertson, James Stewart, yr. of Edradynate, W.S.	1851
	Robertson, James, Hall of Caldwell, Paisley	1852
	Robertson, Captain John, Edinburgh	1825
	Robertson, John, Bank-Agent, Huntly	1847
	Robertson, Lawrence, Banker, Glasgow	1828
	Robertson, Robert, of Auchleeks	1828
2310	Robertson, Robert, younger of Auchleeks	1845
	Robertson, Stewart, of Derculich	1843
	Robertson, William, of Kinlochmoidart	1826
	Robertson, William, Burnside, Ballindalloch	1852
	Robinow, Adolphus, Merchant, Leith	1851
	Robson, Charles, Lurdenlaw, Kelso	1841
	Robson, John, East Kielder, Northumberland	1853
	Robson, William, Auchinduich, Bonar Bridge	1850
	Rodger, David, Penkiln, Garlieston	1851
	Rodger, Robert, Merchant, Glasgow	1838
2320	Rogers, George, Kilconquhar Mains, Colinsburgh	1842
	Rogerson, George, Pearsbyhall, Lockerby	1851
	Rogerson, William, of Gillesbie	1829
	Rolland, Adam, of Gask	1837
	Rollo, David, Currie	1852
	Rose, James, W.S.	1839
	Ross, Alexander, Edinburgh	1844
	Ross, George, of Pitcalnie	1839
	Ross, George W. H., of Cromarty	1849
	Ross, Lieut.-Col. James Kerr, of Lawrence Park	1839
2330	Ross, J. B., Advocate	1839
	Ross, John Leith, of Arnage	1843
	Ross, Colonel John Gray	1836

		Admitted
	Ross, Richard Louthian, of Staffold	1804
	Roughead, David, Seedsman, Haddington	1850
	Rowand, Alexander, younger of Linthouse	184
	Rowand, Michael, of Linthouse, Glasgow	1838
	Roy, Frederick Lewis, of Nenthorn	1837
	Roy, James, jun., Nursery and Seedsman, Aberdeen	1840
	Roy, John James, Avochie, Rothiemay	1825
2340	Roy, Robert, W.S., Chester	1822
	Royle, Dr John Forbes, Honorary Member	1841
	Russell, Alexander James, W.S.	1846
	Russell, Francis Whitworth	1835
	Russell, Henry, Merchant, Dunfermline	1836
	Russell, James, of Aden	1834
	Russell, James, of Blackbraes	1834
	Russell, James, Saughtonhall, Slateford	1848
	Russell, James L., M.D., Thornhill, Secretary, Nithsdale Agricultural Society	1847
	Russell, James, Coulston Mains, Haddington	1851
2350	Russell, John, one of the Principal Clerks of Session	1806
	Russell, Robert, of Dalnair	1834
	Russell, Robert, Kilwhiss, Cupar-Fife	1851
	Rutherford, Walter, Crailing Tofts, Jedburgh	1851
	Rutherfurd, Wm. Oliver, of Edgerston and Dinlabyre	1825
	Ruxton, John, M.D., Hill of Fiddes, Hill of Memie	1851
	Ruxton, William, Farnell, Brechin	1850
	Ryburn, James, Drumlandle, Campbeltown	1850
	*SUTHERLAND, His Grace George Granville, Duke of, K.G.	1813
	SUTHERLAND, Her Grace Harriet, Duchess of	1834
2360	STAFFORD, The Most Noble George Granville William, Marquis of	1849
	STRATHMORE, The Right Hon. Thos. George, Earl of	1852
	†SELKIRK, The Right Hon. Dunbar James, Earl of	1830
	†SEAFIELD, The Right Hon. Francis William, Earl of	1803
	STAIR, The Right Hon. North, Earl of	1843
	†STRATHALLAN, The Right Hon. Wm. Henry, Viscount	1847
	†SALTOUN, The Right Hon. Alexander George, Lord	1820
	SINCLAIR, The Right Hon. Charles, Lord	1829
	SCOTT, The Right Hon. Lord John	1833
	STUART, The Right Hon. Lord James	1819
2370	SYLVESTRE, The Baron de, Paris, Honorary Member	1836
	STUART, General The Hon. Sir Patrick, of Eaglescairnie, G.C.M.G.	1833

		Admitted
	STUART, The Hon. John	1824
	STUART, The Hon. Charles Francis	1826
	SETON, Sir William Coote, of Pitmedden, Bart.	1834
	SINCLAIR, Sir John Gordon, of Stevenston and Murkle, Bart.	1832
	STEWART, Sir Michael Robert Shaw, of Blackhall and Ardgowan, Bart.	1848
	SINCLAIR, Sir George, of Ulbster, Bart.	1812
	SCOTT, Sir William, of Ancrum, Bart.	1829
	STEWART, Sir Wm. Drummond, of Grantully, Bart.	1839
2380	SUTTIE, Sir George Grant, of Balgone and Preston-grange, Bart.	1839
	SINCLAIR, Sir John, of Dunbeath, Bart.	1824
	STEUART, Sir Henry M. Seton, of Allanton and Touch, Bart.	1835
	Sadler, Thomas, Norton Mains, Ratho	1838
	Sadler, William, Ferrygate, Dirleton	1853
	Salmon, Henry, of Bonnyside, Banker, Falkirk	1834
	Salmond, Duncan, Rothesay	1846
	Salmond, Robert, Banker, Glasgow	1845
	Sanderson, Captain Archibald, of Glenlaggan	1844
	Sandford, Erskine Douglas, Advocate, Steward of the Stewartry of Kirkcudbright	1827
2390	Sandilands, Captain William, of Barnyhill	1838
	Sands, William John, W.S.	1849
	Sangster, Robert B., Banker, Golspie	1845
	Sawers, Alexander S., of Newhouse, Dunbar	1850
	Scarth, James, Banker, Leeds	1828
	Scarth, Robert, of Binscarth	1843
	Sceales, Andrew, Blackburn House, Linlithgow	1828
	Scobie, John, Lochinver, Golspie	1851
	Scoon, Kenneth, Castleton, Fushiebridge	1848
	Scot, William, of Craigmuie	1838
2400	Scotland, John, Glen-Douglas, Jedburgh, Factor to Lord Douglas	1835
	Scott, Adam, Tullich, Lochcarron, Ross-shire	1851
	Scott, Alexander, Beanston, Prestonkirk	1850
	Scott, Alexander, Kinninghall, Hawick	1842
	Scott, Alexander, Craiglockhart, Slateford	1844
	Scott, Andrew, Factor for the Marquis of Hastings	1848
	Scott, Carteret G., of Malleny	1842
	Scott, Charles C., of Hawkhill	1831
	Scott, David	1823
	Scott, David, of Brotherton	1849
2410	Scott, David, Northfield, Portobello	1849

		Admitted
	Scott, Captain George, of Wooden	1844
	Scott, Lieutenant-Colonel George, Edinburgh	1821
	Scott, Henry, Crosslee, Selkirk	1853
	Scott, Hugh, of Gala, Captain 92d Highlanders	1846
	Scott, James Fitzmaurice, of Commieston	1843
	Scott, James, of Kelly, Glasgow	1850
	Scott, John, Dunbeath Mains, Dunbeath	1850
	Scott, John, Finnart House, Greenock	1826
	Scott, John, of Halsendean, W.S.	1842
2420	Scott, Robert, Balwyllo, Montrose	1852
	Scott, Capt. Robt., Bellechin, Dunkeld	1841
	Scott, Thomas, of Beechwood	1843
	Scott, Thomas, London	1850
	Scott, Thomas M'Millan, yr. of Wauchope	1843
	Scott, Thomas Rennie, Castle Mains, Douglas, Factor to Lord Douglas	1827
	Scott, Walter, Glendronach, Huntly	1850
	Scott, William Inglis, Merchant, Glasgow	1850
	Sellar, Patrick Plenderleith, Morvich, Golspie	1849
	Seton, George, Advocate	1848
2430	Shairp, Major Norman, of Houston	1823
	Shand, John, W.S.	1844
	Shand, Robert, Advocate, Aberdeen	1840
	Sharp, James, Drums House, Renfrewshire	1846
	Sharp, Thomas, Manufacturer, Paisley	1839
	Shaw, Charles, W.S., Sheriff-Substitute in Skye	1835
	Shaw, David, W.S., Ayr	1836
	Shaw, Patrick, Advocate	1835
	Shaw, Harry, junior, Bogfairn, Tarland	1850
	Shawe, R. F., of Bartinghame Thorpe, Hull	1838
2440	Shepherd, James, W.S.	1828
	Sheriff, Charles, Sheriff-Substitute, Dunfermline	1829
	Shirreff, David, Tomich, Dingwall	1837
	Shirriff, David, Cally Park, Gatehouse, Factor on the Estate of Cally	1847
	Shirriff, Samuel D., Saltcoats, Haddington	1850
	Sidey, James, Pitcairngreen, Perth	1852
	Sim, Adam, of Coulter Mains	1836
	Sim, William, Scotsburn, Dingwall	1839
	Simpson, Alexander Horatio	1830
	Simpson, Alexander, Teawig, Beauly	1846
2450	Simpson, James Y., M.D., Professor of Midwifery, University of Edinburgh	1848
	Simpson, James, Mawcarse, Kinross	1851

		Admitted
	Simpson, Robert, of Cobairdy	1839
	Simpson, William, of Glenythan, Procurator-Fiscal for Aberdeenshire	1835
	Simson, Charles, of Threepwood, Lauder	1850
	Simson, George, of Pitcorthy	1841
	Simson, James, Secretary of the Melrose Farmers' Society, Melrose	1852
	Simson, Thomas, Blainslie, Lauder	1850
	Sinclair, Alexander, H.E.I.C.S.	1839
	Sinclair, Dugald, Kilchamaig, Tarbert	1826
2460	Sinclair, James, of Forss	1830
	Sinclair, John, of Lochaline	1834
	Sinclair, John, of Redcastle	1837
	Sinclair, William James John Alexander, of Freswick	1843
	Sitwell, William H., Sydenham, Kent	1845
	Sivewright, James	1850
	Skelton, George, of Invernettie Lodge	1837
	Skene, George, younger of Rubislaw, Advocate, Sheriff-Substitute of Lanarkshire	1831
	Skene, Moncreiff, younger of Pitlour	1849
	Skene, Patrick George, of Hallyards	1825
2470	Skene, William F., W.S.	1831
	Skinner, Captain C. G. Macgregor, Belfast	1823
	Skinner, James, Drumin, Factor to the Duke of Richmond	1827
	Skirving, James, Luffness Mains, Haddington	1850
	Skirving, Robert Scot, Campton, Haddington	1846
	Slate, John, Sunnyside, Linton	1818
	Sligo, John, of Carmyle	1826
	Smail, William Archibald, of Overmains	1847
	Small, David, Writer, Dundee	1843
	Small, Patrick, of Dirnanean	1826
2480	Small, William, Merchant, Dundee	1843
	Smart, James, Liberton, Edinburgh	1848
	Smith, Alexander, Civil Engineer, Aberdeen	1847
	Smith, Alexander, Engineer, Paisley	1852
	Smith, Archibald, Advocate, Sheriff-Substitute, Airdrie	1838
	Smith, C., Factor on the Estate of Whittingham, Prestonkirk	1853
	Smith, Charles Hope Johnstone, Garden Architect, Edinburgh	1836
	Smith, David, W.S.	1833

		Admitted
	Smith, Donald, Banker, Glasgow	1844
	Smith, Eaglesfield Bradshaw, of Blackwood House, Ecclefechan	1839
2490	Smith, George, Moffat, Surgeon, R.N.	1829
	Smith, George Campbell, Land-Surveyer, Banff	1837
	Smith, George, Distiller, Tenant of Minmore and Castleton	1839
	Smith, James, of Jordanhill	1823
	Smith, James, Architect, Glasgow	1838
	Smith, John, Advocate, Aberdeen	1851
	Smith, John, Harecraig, Dundee, Factor for Lord Douglas	1843
	Smith, John Gordon, Nevie, Ballindalloch	1852
	Smith, Robert, Ladyland, Dumfries	1850
	Smith, Robert, Edinburgh	1839
2500	Smith, Robert Graham, Leith	1826
	Smith, Thomas, Banker, London	1798
	Smith, Thomas, Dalfibble, Lochmaben	1850
	Smith, William, of Carbeth-Guthrie	1823
	Smollett, Alexander, of Bonhill, M.P.	1826
	Smyth, Robert Gillespie, of Gibliston	1834
	Smythe, William, of Methven	1846
	Somerville, James, Merchant, Glasgow	1838
	Somerville, James, Ladyurd, Kirkurd	1848
	Somerville, Samuel, of Ampherlaw, M.D., Edinburgh,	1841
2510	Somerville, Samuel H. May, of Broadfield	1845
	Somerville, Thomas, of Greenfield	1845
	Somerville, William, Merchant, Glasgow	1850
	Souter, David Robertson, Edinburgh	1847
	Souter, Francis George, Edinburgh	1840
	Speid, James, of Forneth	1843
	Speir, Thomas, of Blackston	1838
	Speirs, Archibald, H.E.I.C.S., Ayton House	1852
	Speirs, Thomas Dundas, Mains of Houston	1838
	Spens, Nathaniel, of Craigsanquhar, W.S.	1848
2520	Spens, William, Manager of the Scottish Amicable Assurance Society, Glasgow	1845
	Spooner, Lucius Henry, Munlochy	1850
	Spottiswoode, James Brodie, of Muiresk	1834
	Spottiswoode, John, of Spottiswoode	1812
	Sprot, Alexander, younger of Garnkirk	1850
	Sprot, James, of Spot	1830
	Sprot, John, Edinburgh	1830
	Sprot, Mark, of Garnkirk	1820
	Sprot, Mark, of Riddell	1830

		Admitted
	Sprot, Thomas, W.S.	1826
2530	Stables, William Alexander, Cawdor Castle	1836
	Stedman, James, Banker, Jedburgh	1851
	Steedman, James, Boghall, Burghmuirhead	1847
	Steele, Robert, of Knock Castle	1853
	Steel, Samuel, of Waygateshaw	1849
	Steele, William, Advocate	1828
	Stein, Charles, of Hattonburn	1837
	Stenhouse, George, West Pilton, Blackhall	1850
	Stenhouse, James, Southfield, Corstorphine	1850
	Stenhouse, James, younger of Northfod	1852
2540	Stephens, Henry, Redbrae Cottage, Edinburgh	1826
	Stephens, William, Inchbroom, Elgin	1853
	Stevens, Moses, of Bellahouston	1832
	Stevenson, Alexander, S.S.C.	1813
	Stevenson, Alexander, Banker, Langholm	1839
	Stevenson, Andrew, late Minister Plenipotentiary from the United States of America, Honorary Member	1839
	Stevenson, Charles, Edinburgh	1850
	Stevenson, David, Redside, Lasswade	1851
	Stevenson, Duncan, Printer to the University of Edinburgh	1824
	Stevenson, Captain Hugh	1805
2550	Stevenson, John, Oban	1842
	Stevenson, John, Westfield, South Queensferry	1853
	Stevenson, Thomas, Merchant, Leith	1831
	Stevenson, Thomas, Mount-Lothian, Penicuik	1853
	Steuart, Andrew, of Auchlunkart	1845
	Steuart, Archibald Seton, Alloa	1835
	Steuart, Claud Scott, Dalguise	1843
	Steuart, James, W.S.	1842
	Steuart, Robert, of Carfin	1833
	Steuart, Robert, of Parsons Green	1844
2560	Steuart, William, London	1833
	Stewart, Alexander, Dalvey, Grantown	1852
	Stewart, Charles, Solicitor, Inverness	1840
	Stewart, Charles, of Ardsheal	1846
	Stewart, Charles, of Hillside	1823
	Stewart, Charles, Aberfeldy	1834
	Stewart, David, London	1842
	Stewart, Donald, Ben Nevis, Fort-William	1817
	Stewart, Captain Dugald	1799
	Stewart, George, Kirkchrist, Kirkcudbright	1844

		Admitted
2570	Stewart, Henry, of St Fort	1837
	Stewart, Henry Black, of Balnakiely	1838
	Stewart, Rear-Admiral Houston, of Gart	1822
	Stewart, James, Pitskelly, St. Martins, Perth	1851
	Stewart, James Hope, of Gillenbie	1838
	Stewart, John, of Belladrum	1819
	Stewart, John, of Dalguise	1823
	Stewart, John, of Findynate, M.D., R.N.	1839
	Stewart, John, of Nateby Hall, Lancashire	1851
	Stewart, John, of Binny	1809
2580	Stewart, John, late of Achadashenaig	1824
	Stewart, John, of Cardross, Dumbarton	1851
	Stewart, John Henry Fraser, younger of Belladrum	1843
	Stewart, John Lorn, of Glenbuckie	1824
	Stewart, Mark S., of Southwick	1837
	Stewart, Robert, of Ardvorlich	1823
	Stewart, Robert Hathorn Johnstone, of Straiton and Champfleurie	1846
	Stewart, Stair Hathorn, of Physgill	1828
	Stewart, Thomas, Carterhaugh, Selkirk	1852
	Stewart, William, Sheriff-Clerk, Kincardineshire	1825
2590	Stewart, William, Ballaterach, Ballater	1829
	Stewart, William, of Blackhouse, Largs	1844
	Stewart, William, of Shambellie	1845
	Stewart, William, Tonroich, Campbeltown	1850
	Stirling, James, C.E., Edinburgh	1852
	Stirling, John, of Kippendavie	1833
	Stirling, J. D. Morries, of Blackgrange	1841
	Stirling, Thomas Graham, of Strowan	1839
	Stirling, William, of Content	1823
	Stirling, William, of Keir, M.P.	1841
2600	Stobie, Thomas, Balneathill, Kinross,	1851
	Stodart, George Tweedie, of Oliver, W.S.	1839
	Stodart, John, Jerviswood Mains, Lanark	1829
	Stodart, John, Muirhouse, Carnwath	1851
	Stoddart, Alexander, of Ballendreck	1829
	Storrie, Francis, V.S., East Linton	1850
	Story, John, Merchant, Leith	1851
	Stott, Gibson, Edinburgh	1832
	Strang, William, Lopness, Orkney	1819
	Straton, George Thomas, of Kirkside	1842
2610	Stronach, William, Ardmellie, Aberchirder	1840
	Stuart, Charles, of Ballahulish	1827
	Stuart, Captain John	1809
	Stuart, Samuel M'Dowall, Glasgow	1845

		Admitted
	Stuart, William, Parkdargue, Forgue	1852
	Sturrock, John, Banker, Dundee	1843
	* Sutherland, Eric, Shempston, Elgin	1853
	Sutherland, George, of Forse	1849
	Sutherland, James, Distiller, Glenalbyn, Inverness	1839
	Sutherland, Sinclair, Factor for Sir John Stuart Forbes of Pitsligo, Bart., New Pitsligo, Mintlaw	1852
2620	Sutherland, William, Swiney, Lybster	1839
	Swan, John, Cattle Salesman, Edinburgh	1851
	Swan, Robert, Writer, Kelso	1852
	Swinburne, Colonel T. R., of Marcus	1843
	Swinton, Archibald Campbell, younger of Kimmerghame	1841
	Swinton, George H., Edinburgh	1834
	Swinton, John Campbell, of Kimmerghame, Edin.	1810
	Sydserff, Thomas Buchan, of Ruchlaw	1853
	Syme, James, Professor of Clinical Surgery, University of Edinburgh	1838
	Symers, John, Banker, Dundee	1843
2630	Symington, Thomas, Eastside, Penicuik	1848
	†Tweeddale, Most Noble George, Marquis of, K.T.	1809
	Traquair, The Right Honourable Charles, Earl of	1811
	Torphichen, The Right Honourable James, Lord	1821
	Torphichen, The Hon. Robert Sandilands, Master of	1831
	Threipland, Sir Patrick Murray, of Fingask, Bart.	1824
	Tait, Alexander D., of Milrig	1845
	Tait, George, Advocate	1808
	Tait, James, Banker, Kelso	1846
	Tait, John, Advocate, Sheriff of Kinross and Clackmannan	1834
2640	Tait, Joseph, Auchmillie, Portsoy	1852
	Tawse, John, Advocate, Secretary to the Society for Propagating Christian Knowledge	1825
	Tayler, Major Alexander Francis, Rothiemay House	1814
	Taylor, Farquharson, Wellhouse, Aberdeen	1850
	Taylor, Malcolm, Ardnadam, Dunoon	1853
	Taylor, William, North Queensferry	1828
	Telfer, Alexander Bell, Cunning Park, Ayr	1852
	Tennant, Charles J., St Rollox, Glasgow	1838
	Tennant, Hugh, of Wellpark, Glasgow	1838
	Tennant, John, of St Rollox	1838
2650	Thom, Robert, of Ascog	1844
	Thoms, Alexander, of Rumgay	1842
	Thomson, Alexander, of Banchory	1821

		Admitted
	Thomson, Alexander, Banker, Greenock	1825
	Thomson, Alexander, of Whiterig	1838
	Thomson, Arthur, Banker, Aberdeen	1841
	Thomson, George, of Burnhouse	1836
	Thomson, James, Papple, Haddington	1828
	Thomson, John, of Gogar Bank	1833
	Thomson, John Anstruther, of Charleton	1848
2660	Thomson, Robert John, Hangingside, Linlithgow	1852
	Thomson, Peter, Peffermill, Libberton	1849
	Thomson, Robert, Advocate, Sheriff of Caithness	1835
	Thomson, Thomas, Merchant, Glasgow	1850
	Thomson, Dr William, of Quocies, Stonehaven	1849
	Thomson, William, Dumfries	1843
	Thomson, William, of Balgowan	1844
	Thomson, William, Shelfield, Dunoon	1853
	Thomson, William Thomas, Manager, Standard Assurance Company, Edinburgh	1841
	Thorburn, Kenneth M'K., W.S.	1842
2670	Threshie, David Scott, W.S.	1824
	Threshie, Robert, of Barnbarroch	1835
	Timins, William, of Hillfield, Stanmore, Middlesex	1844
	Tindal, James, Stonehaven, Procurator-Fiscal for Kincardineshire	1849
	Tod, George, Lochran, Blair-Adam	1851
	Tod, Hugh, W.S.	1817
	Tod, John, W.S.	1838
	Tod, John Robert, W.S.	1848
	Tod, Peter, of Meikleholmside	1829
	Tod, William, Gospetrie, Kinross	1851
2680	Tod, William, Cattle Agent, Edinburgh	1851
	Tod, William, Elphinstone Tower, Tranent	1852
	Todd, John, of Finnich, Dumbarton	1838
	Todd, Peter, Burican, Arran	1844
	Torrance, George M'Micken, of Threave	1827
	Torrance, Thomas, Meadowhead, Libberton	1831
	Torrance, William, Gilmerton	1831
	Torrie, Thomas Jameson, Advocate	1837
	Traill, George, of Ratter, M.P.	1822
	Traill, Thomas Stewart, of Tirlot, M.D., Professor of Medical Jurisprudence, University of Edinburgh	1834
2690	Traill, William, of Woodwick, Orkney	1821
	Traquair, Ramsay H., Colinton	1846
	Trotter, Archibald, of Dryden	1845
	Trotter, Charles, Edinburgh	1841

Admitted

Trotter, John P., Advocate, Sheriff-Substitute, Dumfries 1831
Trotter, Richard, of Mortonhall 1836
Trotter, Robert Knox, of Ballindean 1829
Tudhope, George, Colinhill, Strathaven 1850
Turnbull, Archibald, of Bellwood 1826
Turnbull, George, of Abbey St Bathans, W.S. 1833
2700 Turnbull, John, younger of Abbey St Bathans, W.S. 1844
Turnbull, John, Spittal, Hawick 1842
Turnbull, Joseph, Bonhill Place, Dumbarton 1838
Turnbull, Phipps, Crooks, Coldstream 1841
Turnbull, Stewart, Bonhill Place, Dumbarton 1850
Turner, Angus, Town-Clerk, Glasgow 1844
Turner, Lieut.-Colonel George, of Menie 1828
Turner, Duncan, Corachaine, Dunoon 1853
Tweedie, David, Castle Crawford, Abington 1853
Tytler, James, of Woodhouselee 1840
2710 Tytler, William Fraser, of Balmain and Burdsyards, Sheriff of Inverness-shire 1802

Urquhart, Beauchamp Colclough, of Byth and Meldrum 1834
Urquhart, William Pollard, of Craigston, M.P. 1851

Vallentine, James, Woodmyre Cottage, Brechin 1850
Veitch, James, of Elliock 1822
Vere, W. E. Hope, of Craigiehall and Blackwood 1846
Vernor, James A., Hillhead, Musselburgh 1829

†Wemyss and March, The Right Hon. Francis, Earl of 1793
†Willoughby d'Eresby and Gwydir, The Right Honourable P. Drummond Burrell, Lord 1808
Ward, The Right Honourable William, Lord 1843
2720 Walpole, The Honourable Henry, Wolterton Park 1845
Waddell, William, of Easter Moffat, W.S. 1818
Waldie, John, Kelso 1824
Waldie, John, of Henderside 1826
Walker, Bethune James, of Fallfield 1835
Walker, Charles, Drumblair, Huntly 1847
Walker, James, of Dalry, Principal Clerk of Session 1835
Walker, James, of Blairton 1847
Walker, John, of Crawfordton 1834
Walker, John, W.S. 1848
2730 Walker, Matthew, Glasgow 1844

		Admitted
	Walker, Robert, Montbletton, Banff	1853
	Walker, Robert, Lathamhill, Barony	1844
	Walker, Robert, Mains of Portlethen, Kincardineshire	1847
	Walker, Dr Thomas, of Polmont Bank	1843
	Walker, William S., of Bowland	1835
	Wallace, David, Balgrummo, Leven	1852
	Wallace, Patrick, Coach-Builder, Perth	1842
	Wallace, Robert	1825
	Wallace, William, of Auchiavole	1844
2740	Walrond, Theodore, of Calder Park	1850
	Warner, Patrick, of Ardeer	1841
	Wason, Rigby, of Corwar	1836
	Waterston, Charles, Banker, Inverness	1839
	Watson, George, Liberton Mains, Edinburgh	1848
	Watson, Henry George, Accountant, Edinburgh	1841
	Watson, Hugh, Keillor, Coupar-Angus	1828
	Watson, John, Manager of the Edin. Gas-Light Co.	1825
	Watson, Peter, Campbeltown	1847
	Watson, Robert, Town-Clerk, Forres	1841
2750	Watson, R. H., Bolton Park, Cumberland	1852
	Watson, Thomas, Esperston, Fushie Bridge	1852
	Watson, William, Auchtertyre, Coupar-Angus	1852
	Watson, William, of Burngrove	1841
	Wauchope, Andrew, of Niddrie Marischall	1840
	Wauchope, John, of Edmonstone	1842
	Waugh, Robert, Eweford, Dunbar	1850
	Webster, Alexander, Advocate, Aberdeen	1840
	Webster, John	1839
	Webster, William	1838
2760	Wedderburn, David, of Pearsie	1831
	Wedderburn, Frederick L. S., of Wedderburn and Birkhill	1844
	Weems, Robert, of Kirkennan	1848
	Weir, Thomas Graham, of Tollcross, M.D., Edinburgh	1849
	Welsh, Alex., Spott, Dunbar	1850
	Welsh, David, of Collin, W.S.	1830
	Welsh, James, of Earlshaugh	1826
	Welsh, Robert, of Mossfennan	1840
	Wemyss, Dr Alex. Watson, of Denbrae, St Andrews	1851
	Wemyss, David Sinclair, of Southdun	1846
2770	Wemyss, Rear-Admiral James Erskine, of Wemyss, Lord-Lieutenant of the County of Fife	1823
	Wemyss, James, of Wemyss Hall	1841

		Admitted
	Wetherell, William, Land-Agent, Durham	1836
	White, Alexander, of Fens, Merchant, Leith	1829
	White, George, Bridgend of Auchlee, Mintlaw	1851
	White, Henry W., of Monar	1842
	White, J., Ballochoyle, Dunoon	1853
	White, James, Merchant, Leith	1842
	White, John, of Drumelzier	1842
	White, John, Harthill, Secretary, Whitburn Agricultural Society	1853
2780	White, Peter, Accountant, Glasgow	1838
	White, Robert, W.S.	1842
	White, William, Merchant, Glasgow	1838
	Whitehead, Joseph, younger of Kilnside	1845
	Whittet, George, Whitehouse, Cramond	1850
	Whitton, Andrew, of Couston	1843
	Whyte, Thomas, of Glenesslyn	1829
	Wightman, James Seton, of Courance	1827
	Wilkie, Duncan, Kirriemuir	1843
	Wilkie, William, of Bonnington	1824
2790	Wilkie, John, of Foulden	1830
	Williamson, Donald, Banker, Tain	1847
	Williamson, George, Auldtown of Carnousie, Turriff	1850
	Williamson James, Newton of Mountblairy, Banff	1853
	Williamson, John, Veterinary Surgeon, Edinburgh	1848
	Williamson, John W., of West Green, Banker, Kinross	1829
	Wilson, Alexander, Kilnhilloch, Cullen	1842
	Wilson, Alex. Todd, Rawburn, Dunse	1852
	Wilson, Andrew, Waterside of Forbes, Aberdeen	1850
	Wilson, David, of Inchrye Abbey, Newburgh	1848
2800	Wilson, Francis Johnstone, of Stroquhan	1843
	Wilson, George, Dalmarnock, Glasgow	1847
	Wilson, George, M.D., Lecturer on Chemistry, Edinburgh	1845
	Wilson, James, Auchaleek, Campbeltown	1848
	Wilson, James, Nether Mains of Pitfour, Perth	1852
	Wilson, James, Banker, Inverness	1840
	Wilson, James, Corn-Merchant, Dundee	1843
	Wilson, James, Edinburgh	1848
	Wilson, James, Woodburn, Dalkeith	1848
	Wilson, James, Glasgow	1844
2810	Wilson, John, of Auchinden	1835
	Wilson, John, Eastfield, Penicuik	1848
	Wilson, John, of Cumledge	1841
	Wilson, John, Edington Mains, Ayton	1851

		Admitted
	Wilson, John, Billholm, Langholm	1850
	Wilson, John C., Redford Flax Factory, Kirkcaldy	1852
	Wilson, Robert Sym, of Woodburn	1841
	Wilson, Robert, Durn, Portsoy	1852
	Wilson, Robert, Firthfield, Anstruther	1852
	Wilson, William, of Campbellfield	1843
2820	Wilson, William, Kinneil Iron-Works, Bo'ness	1853
	Wilson, Wm., Land-Stewart to Sir Graham Graham Montgomery, of Stobo, Bart.	1853
	Wilson, William, W.S.	1849
	Wilsone, George Ross	1826
	Wingate, Andrew, Merchant, Glasgow	1838
	Wood, John, Factor on the Estate of Balcarres, Colinsburgh	1835
	Wood, J. Stewart, Edinburgh	1844
	Wood, William, Merchant, Leith	1828
	Wood, William E. Collins, of Keithock	1841
	Woolley, Richard, Spittal, Berwick-on-Tweed	1821
2830	Woolfield, Samuel, of Balquhain	1852
	Wright, David, Southfield, Gladsmuir	1850
	Wright, James, of Lawton	1817
	Wright, James, Glasgow	1839
	Wright, John B., Hedderwick Hill, Dunbar	1848
	Wright, Major-General, Royal Engineers	1833
	Wyld, James, of Gilston	1802
	Wylie, David, Circuit-Clerk of Justiciary, Edinburgh	1825
	Wylie, James F., Bolfracks, Aberfeldy, Factor for the Marquis of Breadalbane	1833
	Wylie, James, Bloom, Mid-Calder	1852
2840	Wyllie, John, New Farm, Mid-Calder	1849
	Wyllie, William Macfarlane, Brucefield, Mid-Calder	1850
	Yeats, William, of Aquharney, Advocate, Aberdeen	1838
	Young, Alexander, Keir Mains, Dunblane	1852
	Young, Charles D., Wire Manufacturer, Edinburgh	1852
	Young, Harry, of Cleish Castle	1842
	Young, James, of Gallowhill	1852
	Young, James, Land-Surveyor, Perth	1841
	Young, John, Niddry, Winchburgh	1852
	Young, Joseph, Grange, Burntisland	1848
2850	Young, Samuel D.	1826
	Young, Captain William Baird, of Ascreavie House, Kirriemuir	1852
	Young, William, W.S.	1821
	Young, William, junior, Burntisland	1848

	Admitted
Yuille, Andrew Buchanan, of Darleith	1838
Yule, John, Factor to Sir James Graham of Netherby, Bart., M.P.	1828
Yule, Lieut.-Colonel Patrick, Royal Engineers	1827
Yule, Thomas B., Beechwood Mains, Murrayfield	1852
2858 ZETLAND, The Right Hon. Thomas, Earl of	1840